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The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. ONE CRANK SHAFT GRINDING MACHINE.
2. ONE HYDRAULIC LOCOMOTIVE WHEEL PRESS, 600 Tons.
Tenders due on the 23rd August, 1927, for No. 1, and on the 25th August, 1927, for No. 2.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 6231

Required to Hire for Royal Air Force Display at Hendon, in Summer, 1928, STANDS to seat up to Fifty Thousand persons.
Particulars from—
DISPLAY SECRETARY,
6190 Hillingdon House, Uxbridge.

Assistant Engineers (2) REQUIRED for the RAILWAY DEPARTMENT of NIGERIA, for a tour of 12 to 18 months' service, with possible extension. Salary, £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications, and have had experience in Maintenance and Construction on a recognised Railway in the United Kingdom or a British Colony. A good knowledge of Surveying is essential.—Apply at once by letter, stating age and particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W.1, quoting M/15,394. 6184

Assistant Engineers (20) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other diploma or distinction in engineering as the Secretary of State may decide in any particular case or have completed articles with a civil engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15224. 6105

The Government of INDIA REQUIRE THREE INSPECTORS OF STORES for the Indian Stores Department. Qualifications :—Age, about 24-26 years ; A.M.I.C.E. or A.M.I.M.E. examination or engineering degree exempting therefrom ; regular Mechanical Engineering Apprenticeship or Pupilage, and subsequently at least two years' experience in a position of responsibility ; at least six months' drawing-office experience.
Five years' agreement in first instance. Pay at the rate of Rs. 500, rising by annual increments of Rs. 50 to Rs. 750 per calendar month, with certain allowances subject to the rules in force. Free first-class passage to India. Provident Fund. Strict medical examination.
Forms of application and further particulars may be obtained (upon request by post-card) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications, 22nd August, 1927. 6199

The Government of INDIA REQUIRE the SERVICES of TWO ASSISTANT FOREMEN for the Indian Ordnance Department.
GUN and SHELL FACTORY, Cossipore. Appointment 86/1. Candidates must have served a recognised apprenticeship in an Engineering Works, have had sound theoretical training, and possess a knowledge of Heat Treatment of Steels. Subsequent experience in Tool-room of up-to-date firm also necessary, combined with a knowledge of Gauge Design. Actual experience in the Inspection of Raw Materials before issue to Stores an advantage.
Age 25-35 years.
GUN CARRIAGE FACTORY, Jubbulpore. Appointment 89. Must have served an apprenticeship in, and had subsequent practical experience in, an up-to-date Machine Shop in high-class work, and have had a sound general education. Should be able to fix rates on work passing through shops and estimate from drawings, and preferably have experience of Ordnance Work in Carriage Branch. Practical experience of the Machinery (more especially Boring) of Recuperators, also knowledge of Broaching, useful. Organising ability required. Age should not be more than 30 years.
Salary (for both appointments), Rs. 450-15-510 per calendar month, with prospects of further increases.
TERMS.—Agreement for five years in the first instance. Free second-class passage to India and return passage on satisfactory termination of services. Free quarters. Medical examination.
Further particulars and forms of application may be obtained (on request by post-card quoting the number of the appointment) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications, 27th August, 1927. 6205

Royal Indian Marine. The Secretary of State for India proposes shortly to make THREE APPOINTMENTS of ENGINEER SUB-LIEUTENANTS in the Royal Indian Marine. Candidates must be British subjects between the ages of 21 and 23, and must have served at least five years as apprentice engine fitters in a recognised engineering firm or Government dockyard.—Further details and forms of application from the SECRETARY, Military Department, India Office, S.W. 1. Applications should be made immediately. Selected candidates will be required to accept transfer to the Royal Indian Navy when it is constituted. 6229

University of Birmingham.
APPOINTMENT OF ASSISTANT LECTURER IN THE DEPARTMENT OF MECHANICAL ENGINEERING.
APPLICATIONS are INVITED for the POST of ASSISTANT LECTURER on MACHINE DESIGN. Stipend, £300 per annum. Duties to begin 1st October, 1927. Four copies of application, with testimonials, must be sent on or before August 24th to the undersigned, from whom further particulars may be obtained.
C. G. BURTON, Secretary.
The University, Edmund-street, Birmingham.
August, 1927. 6134

Crystal Palace School of Practical Engineering, Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT : J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL : MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 5881

University of Birmingham.
DEPARTMENT OF METALLURGY.
"FEENEY" PROFESSOR : D. HANSON, D.Sc.
THE SESSION 1927-28 COMMENCES ON OCTOBER 3RD, 1927.
The Course of Study covers three years and leads to the Degree of B.Sc. in Metallurgy. There is also an Honours School. Special attention is devoted to Iron and Steel, Copper, Brass, Metallography, the needs of local industries and to preparation for Colonial and Foreign Posts.
Research and other Scholarships.
For particulars apply to the REGISTRAR. 6076

University of Manchester.
FACULTY OF SCIENCE.
DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.
COMPLETE COURSES of STUDY extending over three years, lead to the University Degree in Civil, Mechanical, and Electrical Engineering. Students who have shown exceptional ability during the first year are admitted to the Honours Courses. A Prospectus giving full particulars may be obtained on application to the REGISTRAR. The Session commences on Thursday, October 6th.
DEPARTMENTS.
Professor A. H. GIBSON, D.Sc., M. Inst. C.E., M.I. Mech. E. (Engineering).
Professor ROBERT BEATTIE, D.Sc. (Electrical Engineering).
Professor E. A. MILNE, M.A., M.Sc., F.R.S. (Applied Mathematics).
Professor L. J. MORDELL, B.A., M.Sc., F.R.S. (Pure Mathematics).
Professor ARTHUR LAPWORTH, D.Sc., LL.D., F.R.S. (Chemistry).
Professor R. ROBINSON, D.Sc., F.R.S. (Chemistry).
Professor W. L. BRAGG, M.A., F.R.S., Nobel Laureate (Physics).
Professor F. C. THOMPSON, B.Sc., D.Met. (Metallurgy).
Professor O. T. JONES, M.A., D.Sc., F.R.S. (Geology).
Students specialising in Water Supply and Irrigation work under the direction of Associate-Professor E. SANDEMAN, M.Sc., M. Inst. C.E. 6204

PUBLIC NOTICES

University College of Swansea.
(A Constituent College of the University of Wales.)
APPLIED SCIENCE DEPARTMENTS.
ENGINEERING.
Professor : FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering : R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering : A. A. FORDHAM, B.Sc. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Assistant Lecturer : J. SELWYN CASWELL, A.M.I. Mech. E.
METALLURGY.
Professor : C. A. EDWARDS, D.Sc. (Manchester).
Lecturer : L. B. PFEIL, D.Sc. (Lond.), A.R.S.M.
Assistant Lecturers : J. C. ARROWSMITH, M.Met. (Sheffield) ;
J. C. JONES, M.Sc. (Wales).
The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to works of practical educational value to the Students.
Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (a) Civil Engineering ; (b) Mechanical Engineering ; (c) Electrical Engineering ; (d) Metallurgy ; and (2) for Diplomas of the College in (a) Civil Engineering ; (b) Mechanical Engineering ; (c) Electrical Engineering ; (d) Metallurgy.
Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such classes.
Entrance Scholarships will be offered for competition in September, 1927.
Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.
EDWIN DREW, Registrar.
Singleton Park, Swansea. 5996

UNIVERSITY OF LONDON.
King's College.
FACULTY OF ENGINEERING.
COMPLETE COURSES of STUDY are provided in CIVIL, MECHANICAL and ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.
HEADS OF DEPARTMENTS :
Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering (Dean).
S. J. DAVIES, M.Sc., M.I. Mech. E., Reader in Mechanical Engineering.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.
C. H. LOBBAN, D.Sc., A.M. Inst. C.E., Reader in Civil Engineering.
Professor E. WILSON, M. Inst. C.E., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Senior Lecturer.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }
Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.
There is a College Hostel and a large Athletic Ground.
For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 6073

Bradford Education Committee.
TECHNICAL COLLEGE.
APPLICATIONS are INVITED for APPOINTMENT as ASSISTANT LECTURER in MECHANICAL ENGINEERING in the College.
Salary according to the Burnham Technical Awards Full particulars of the appointment, and forms of application may be obtained from the Director of Education, Town Hall, Bradford, and completed applications should be returned to the Principal of the College not later than 5th September, 1927.
6244 N. L. FLEMING, Town Clerk.

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PUBLIC NOTICES

B.B. & C.I. Railway Company.

The Directors are prepared to receive up to Noon on Wednesday, 24th August, TENDERS for the SUPPLY of—

1. STEEL SLEEPERS.
2. STEEL SLEEPER KEYS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of £1 each for No. 1 and 10s. each for No. 2 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France, S.W. 1,
5th August, 1927. 6182

Corporation of Durban, Natal.

The Corporation of Durban, Natal, is prepared to receive TENDERS (from manufacturers only) for the SUPPLY and DELIVERY, "Free on Board" British port (or C.I.F. or Stores, Durban, if convenient), of 10 MILES of TRAM RAILS complete with TIE-BARS, FISH-PLATES and BOLTS, to be approved by the Representative Engineers, Messrs. W. H. Radford and Son, Albion Chambers, Kingstreet, Nottingham.

On deposit of £2 2s., returned on receipt of bona fide Tender, specifications can be obtained from, and sealed and endorsed Tenders must be delivered to the undersigned on or before August 24th, 1927.

The lowest or any Tender will not necessarily be accepted.

By Order,
WEBSTER, STEEL & CO.,
36, Leadenhall-street, London, E.C. 3,
6210 Agents to the Durban Corporation.

Government of Egypt.

MINISTRY OF PUBLIC WORKS.

TENDERS will be received at the office of the Director-General, Mechanical Department, Public Works Ministry, Cairo, until Noon, 26th October, 1927, for the SUPPLY and ERECTION at site of Helwan Power Station of THREE TURBO-ALTERNATOR GROUPS and Accessories; and also until Noon, 2nd November, 1927, for the SUPPLY and ERECTION at site of Esna Power Station of TWO TURBO-ALTERNATOR GROUPS and Accessories.

These form two entirely separate Tenders. Conditions of the respective Tenders, specifications and drawings may be obtained from the office of the CHIEF INSPECTING ENGINEER, Egyptian Government, 41, Tothill-street, London, S.W. 1, against payment of Twenty-one Shillings per set (which payment is not returnable). 6173

Great Southern Railways.

STEEL WORK IN ROOF TRUSSES.

The Directors are prepared to receive TENDERS for the SUPPLY and DELIVERY of about 11½ TONS of STEEL WORK required in 21 Roof Trusses.

Specification and drawings can be obtained on payment of 10s. (which is not returnable) from the Chief Engineer, Mr. J. F. Sides, Broadstone Station, Dublin.

The Directors do not bind themselves to accept the lowest or any Tender.

Tenders, in envelopes endorsed "Tender for Steel Work in Roof Trusses," must reach the undersigned not later than 5 p.m. on 29th August, 1927.

C. E. RILEY, Secretary.

Kingsbridge Station, Dublin,
August, 1927. 6219

North Darley Urban District Council.

WATER SUPPLY FROM SYDNOPE.

The North Darley Council invite TENDERS from contractors for SINKING a WELL 48ft. deep and DRIVING 60 YARDS of TUNNEL in the Millstone Grit at Sydnope, and for PROVIDING and LAYING about 2¼ MILES of 6in. CAST IRON PIPE from Sydnope to Two Dales.

The plans and specification may be seen at the offices of the Engineers, Messrs. G. and F. W. Hodson, M. Inst. C.E., Bank Chambers, Loughborough, and copy of the schedule of works obtained from them on deposit of cheque for £5 5s., which will be refunded on receipt of a bona fide Tender and the return of the documents.

Tenders are to be sent to the undersigned not later than the 24th day of August, 1927.

The Council do not bind themselves to accept the lowest or any Tender.

Dated the 27th day of July, 1927.

F. C. LYMN,
Clerk to the Council.

Westminster Bank Chambers, Matlock. 6131

Liverpool Corporation Waterworks.

PUMPING MACHINERY.
RAINHILL, LANCS.

TENDERS are INVITED for the SUPPLY and ERECTION of PUMPING PLANT, consisting of small Electrically Driven Centrifugal Pumps, at Rainhill, Lancashire.

Copies of the specification and form of Tender can be obtained from the Water Engineer, 55, Dale-street, Liverpool, upon payment of the sum of Two Guineas, which amount will be returned upon receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Pumping Machinery," and addressed to "The Town Clerk, Municipal Buildings, Liverpool," are to be forwarded through the post so as to be delivered not later than Twelve o'clock Noon on Tuesday, 13th September, 1927.

The Water Committee do not bind themselves to accept the lowest or any other Tender.

WATER MOON,
Town Clerk.

Municipal Buildings,
Liverpool,
8th August, 1927. 6186

The Government of Baroda are

prepared to receive TENDERS for ONE SEA-GOING STEAM TUGBOAT of 500 horse-power. Particulars and general specification can be obtained from the Consulting Engineers for Harbours, Messrs. C. S. MEIK and BUCHANAN, 16, Victoria-street, Westminster, London, S.W. 1, on and after the fifteenth day of August, to whom Tenders are to be delivered not later than 6 p.m. on 31st August, 1927. The Government of Baroda do not bind themselves to accept the lowest or any Tender. 6215

Walsall Corporation and the

WEST MIDLANDS JOINT ELECTRICITY AUTHORITY.

EXTENSION OF BIRCHILLS GENERATING STATION.

CAST IRON PIPES, VALVES, &c., AND EXCAVATION.

The Walsall Corporation, on behalf of the West Midlands Joint Electricity Authority, invite TENDERS for the EXCAVATION of TRENCHES and REINSTATEMENT and for the SUPPLY and LAYING or ERECTION of CAST IRON PIPES, VALVES, &c.

Instructions for Tender, form of Tender, form of contract, specification and bill of quantities may be obtained from Mr. E. M. Lacey, M. Inst. C.E., of 12, Victoria-street, Westminster, S.W. 1, on and after Monday, August 15th, 1927, on payment of a deposit of £5, which will be returned on receipt of a bona fide Tender.

The general conditions of contract and the drawings can be seen at 12, Victoria-street, Westminster, and also at Birchills Power Station, Walsall.

The contract will include the usual clause ensuring the payment of the standard rate of wages current in the district.

Tenders must be sealed and endorsed as directed and delivered to the undersigned on or before Monday, September 5th, 1927.

The Corporation does not bind itself to accept the lowest or any Tender.

HERBERT LEE,
Town Clerk.

Council House, Walsall,
9th August, 1927. 6218

PUBLIC NOTICES

Great Western Railway.

The Directors of this Company are prepared to receive TENDERS for the DEMOLITION of the LLANBRADACH VIADUCT on the abandoned line of railway between Penrhos Lower Junction and Barry Junction, near Llanbradach Station, and for the PURCHASE of the MATERIALS in situ.

Form of Tender, specification and plan, may be obtained at the office of the Engineer at Cardiff (Queen-street) Station on and after Friday, the 19th instant, between the hours of 10 a.m. and 4 p.m.

Tenders, addressed to the undersigned and marked outside "Tender for Materials, Llanbradach Viaduct," will be received not later than 10 a.m. on Friday, the 23rd proximo.

The Directors do not bind themselves to accept the highest or any Tender.

F. R. E. DAVIS,
6243 Secretary.
Paddington Station, London, 12th August, 1927.

City of Hereford.

APPOINTMENT OF CHIEF ELECTRICAL ENGINEER.

The Corporation of Hereford invite APPLICATIONS for the above POSITION.

Particulars of duties, qualifications, conditions of service, and form of application may be obtained from the undersigned.

The salary will be £800 per annum.

Applications must be received on or before Saturday, 27th August, 1927.

ROBERT BATTERSBY,
Town Clerk.

Town Hall, Hereford,
9th August, 1927. 6217

Local Appointments Commission.

POSITIONS VACANT—ASSISTANT ENGINEER AND DRAUGHTSMAN.

The Local Appointments Commissioners invite APPLICATIONS for the following POSITIONS in the Electricity Department of the Dublin Corporation:—

EXTENSIONS ENGINEER, to assist the City Electrical Engineer, who acts as Consulting Engineer on general extension work, both at the generating works and on the system generally. Salary £42 per month. Applicants must have acted in a similar capacity assisting a Consulting Engineer, and must be qualified Civil, Mechanical and Electrical Engineers.

DRAUGHTSMAN, whose duties will be mainly connected with extensions to the buildings, steam and electrical plant at the generating works and extensions of the cable network, Sub-stations, &c. Salary £25 per month. Applicants must have had experience of similar work and be familiar with the General Arrangement and Design of Power Installations and Distribution Systems.

The posts are whole-time and temporary, terminable at a month's notice on either side. Subject to a probationary period of two months and to satisfactory service, the appointments will be for a minimum duration of twelve months.

The appointments will be made by the Dublin Co. Borough Commissioners on the recommendation of the Local Appointments Commissioners. Preference will be given to qualified candidates with a knowledge of Irish. Latest date for receiving applications, which must be on the prescribed form, is 25th August, 1927. Forms and particulars may be obtained from the SECRETARY, Local Appointments Commission, 33, St. Stephen's Green, Dublin.

13/8. 1224. 6194 W. H. Co.

9th August, 1927.

The Egyptian State Railways

REQUIRE the SERVICES of a SIGNAL INSPECTOR for the Engineering Department. He should have a knowledge of Electro-pneumatic Signalling and at least ten years' experience in Railway Signalling. Salary offered is £E450 per annum; contract period two years.—Application form can be obtained from

THE CHIEF INSPECTING ENGINEER,
Egyptian Government,
6216 41, Tothill-street, London, S.W. 1.

The Egyptian State Railways

REQUIRE the SERVICES of TWO PERMANENT WAY ENGINEERS, one at £E450 per annum and the second at £E360 per annum. Particulars in regard to appointment can be obtained on application to

THE CHIEF INSPECTING ENGINEER,
Egyptian Government,
6123 41, Tothill-street, Westminster, S.W. 1.

The Municipality of the City OF EAST LONDON, SOUTH AFRICA.

CORPORATION NOTICE, No. 101 OF 1927.
ELECTRICITY DEPARTMENT.
POWER STATION ENGINEER.

APPLICATIONS are INVITED for the POSITION of POWER STATION ENGINEER.

Full particulars as to duties, salary and conditions of appointment may be obtained from Messrs. Dyer and Dyer, Ltd., 17, Aldermanbury, London, E.C. 2.

Applications, by letter, in applicants' own handwriting, stating age, and giving full particulars as to training and experience, together with copies of testimonials, must reach Messrs. Dyer and Dyer, Ltd., 17, Aldermanbury, London, E.C. 2, not later than Tuesday, the 30th day of August, 1927.

By Order,
ROBERT E. DOWDING,
Town Clerk.

City Hall,
East London,
South Africa,
19th July, 1927. 6234

Western Australian Government Railways.

DESIGNING DRAUGHTSMAN WITH EXPERIENCE IN STEEL CAR AND WAGON CONSTRUCTION.

1. APPLICATIONS from qualified DRAUGHTSMEN are INVITED to fill the above POSITION.
2. Applicants must be fully qualified Car and Wagon Designers, and should have had several years' actual experience in the designing of the latest type of Steel Car and Wagon Stock, including workshops practice.
3. Age not to exceed 35 years.
4. Commencing salary £448 per annum, subject to Rules and Regulations of the Western Australian Government Railways and the conditions and privileges of the Departmental Salaried Staff Regulations.
5. The period of engagement will be for three years, with two annual increments of £20 to £488, in accordance with terms of engagement.
6. The successful applicants will require to take up duties at Midland Junction, Western Australia, within four months from date of selection.
7. Second-class fare by mail steamer will be allowed to Western Australia and half-pay on voyage from date of sailing until arrival in Western Australia.
8. Application by letter, accompanied by testimonials and certificate or statutory declaration as to date of birth and nationality, should set forth concisely the technical qualifications, general education, age and experience of applicant, stating whether married or single, and be forwarded to reach the AGENT-GENERAL FOR WESTERN AUSTRALIA, Savoy House, Strand, London, W.C. 2, not later than 30th September, 1927. 6205

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, RATE-FIXER for Small Works on North-East Coast; experience of Gear Cutting and Machine Work generally essential.—Address, stating age, experience, salary required and when at liberty, 6132, The Engineer Office. 6132 A

SITUATIONS OPEN (continued)

WANTED for India, ENGINEER SALESMAN, conversant with Air Compressing and Pneumatic Plant for mining and workshop use. Age not over 36, must be single.—State fullest details of education, experience, present work, and salary to "Z.R. 807," Deacon's Advertising Agency, Fenchurch-avenue, London. 6213 A

WANTED for Large General Engineering and Constructional Works on N.E. Coast, First-class COST and ESTIMATE CLERK, accustomed to complete tenders. Only those thoroughly qualified need apply. State age, experience, and salary expected, together with recent references.—Address, 6192, The Engineer Office. 6192 A

WANTED, Young ENGINEER of Good Social standing, education and university degree, workshop experience necessary, for Railway Engineering Firm in Calcutta. Permanent post, officer grade, excellent prospects leading to director.—Address, 6208, The Engineer Office. 6208 A

BLAST-FURNACE MANAGER.—An ASSISTANT REQUIRED. Must be competent, practical man, used to control of Hematite Blast-furnaces, with a thorough grasp of the process and used to handling men.—Apply, with full particulars as to age, qualifications, experience, and salary required, to SECRETARY, Consett Iron Co., Ltd., Consett, Co. Durham. 6164 A

CHIEF ENGINEER REQUIRED by Important Manufacturing Company having factories in Holland, Germany and France, to Take Charge of the Maintenance and Improvements of Buildings, Machinery and Equipment. Position necessitates residence Continent and frequent visits to factories. Only energetic practical men having good factory experience and thorough knowledge boilers, steam engines, electric generators and motors, also general mechanical equipment need apply. Age about 35 to 45. Knowledge German and French an advantage.—Address, giving full particulars past experience, age, salary required, 6180, The Engineer Office. 6180 A

CIVIL ENGINEER REQUIRED for Senior Post on important Railway in South America. Must have had experience in Mountain Construction Work and Maintenance in country subject to heavy rains.—Apply, with record of experience, by letter to "T. X." c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 6183 A

CONTINENTAL WORKS REQUIRE the SERVICES of an English ELECTRICAL ENGINEER in their head estimating office in Central Europe. Must have had at least 5 years' experience in preparation of tenders for Indian, South African, South American, and other foreign and colonial railways where British standards are in operation. Candidates must be accustomed to working out estimates entirely on their own responsibility.—Write, stating age, salary required, to Box 292, c/o Judd's, 47, Gresham-street, E.C. 2. 6197 A

CONTRACTOR'S ENGINEER and AGENT REQUIRED. Able speak Italian, preferably with experience in Italian construction works.—Address, stating age, experience, and salary required, 6179, The Engineer Office. 6179 A

MECHANICAL ENGINEER WANTED IMMEDIATELY for Nigeria, to Install and Run a Repair Shop. Must be good fitter and have electrical knowledge. State age, experience, wages required.—Box M. 990, c/o Dawson's, 118, Cannon-street, London, E.C. 4. 6214 A

PRACTICAL ENGINEER of Good Education, to Take Charge of Small Repair Works in East London. State age, experience, and wages.—Address, P3498, The Engineer Office. P3498 A

REQUIRED for India, Experienced SALESMAN for Railway Requirements. Age not over 24.—Reply, giving fullest details education, training, experience, present work, and salary, to Z.P. 806, Deacon's Advertising Agency, Fenchurch-avenue, London. 6212 A

SALESMAN REQUIRED, Preferably Residing Leicestershire, for De Laval Centrifugal Oil Purifiers, &c. Expert salesmanship combined with engineering and technical knowledge essential. Salary and commission. Good prospects.—DE LAVAL CO., 34, Grosvenor-road, S.W. 1. P3497 A

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WORKS MANAGER WANTED in London District; must have good experience in Machining Vulcanite and also good knowledge of Electroplating; must be good organiser and production man. Only those having such experience need apply.—Write, with full particulars and state salary required, to Box 305, Sells, Fleet-street, E.C. 4. 6233 A

WORKS MANAGER, with Good All-round Experience, accustomed to control of men. Works comprise foundry (green sand and loam moulding, iron and heavy bronze castings), turning, fitting and erecting shops, blacksmiths' and joiners' shops, about 100 men in all.

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WANTED, Experienced STEEL WORKS DRAUGHTSMAN for Sheffield district. Must be quick and accurate.—Address, stating experience, age, and salary required, 6193, The Engineer Office. 6193 A

WANTED, First-class DRAUGHTSMAN, with experience of Vertical Oil Engines of the Airless Injection Type. State age, salary, and qualifications, and when at liberty.—Apply by letter only to BROWETT, LINDLEY and CO., Ltd., Patricroft, nr. Manchester. 6226 A

WANTED, First-class MECHANICAL DRAUGHTSMAN, with experience in the design of High-speed Steam Engines, Condensing Plant, and Air Compressors. State age, salary and qualifications, and when at liberty.—Apply by letter only to BROWETT, LINDLEY and CO., Ltd., Patricroft, nr. Manchester. 6227 A

WANTED, ONE MAINTENANCE ENGINEER, ONE ELECTRICAL ENGINEER and TWO DRAUGHTSMEN for large Chemical Works in Lancashire. Only first-class men having experience in Chemical Work need apply. State age, experience, references and salary required to Box 59, c.o. Mather and Crowther, Ltd., 10-13, New Bridge-street, E.C. 4. 6235 A

A DRAUGHTSMAN ENGINEER, with Good Experience in design of Quarrying Plants, including Stone Crushing, Mixing, &c. Give particulars of age, experience, and salary required.—Address, 6232, The Engineer Office. 6232 A

DRAUGHTSMEN.—Manchester FIRM of CONSTRUCTIONAL ENGINEERS REQUIRE ONE or TWO good LEADING DRAUGHTSMEN, capable of taking charge of large contracts. Good salaries will be paid to the right men.—Address, stating age, qualifications, when at liberty, &c., 6196, The Engineer Office. 6196 A

DRAUGHTSMAN (JUNIOR), with Pumping Machinery experience, REQUIRED for East Midlands. State experience, previous employers, age, salary required.—Address, 5997, The Engineer Office. 5997 A

DRAUGHTSMAN REQUIRED by London Constructional Engineers for Designing. Used to working under London Building Acts and able to design economically. Full particulars of experience, age, &c.—Address, 6189, The Engineer Office. 6189 A

SITUATIONS OPEN (continued)

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DRAUGHTSMAN REQUIRED, London District, man thoroughly conversant with Design of Plant for the Pressing and Stamping out of Sheet Metal.—Address, P3482, The Engineer Office. P3482 A

DRAUGHTSMAN REQUIRED, with Experience in the Design of Concrete Mixing Machinery. State age, experience and salary required.—Address, 6242, The Engineer Office. 6242 A

DRAUGHTSMAN REQUIRED, Thoroughly Experienced in design of full power Petrol and Paraffin Engines and complete plants, land and marine.—Address full particulars in confidence, 6181, The Engineer Office. 6181 A

INDIA.—BRITISH FIRM of ENGINEERS REQUIRE a DRAUGHTSMAN accustomed to Roof, Bridge, and Structural Steel Work, able to work out stresses and prepare designs, estimates, and detail drawings. Must be a bachelor, age 22 to 25.—Apply, stating age and experience, to Z.T. 807, Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 6211 A

JUNIOR DRAUGHTSMAN REQUIRED, with experience in modern Thrashing Machine and Maize Sheller practice. State age, experience, and salary required.—RANSOMES, SIMS and JEFFERIES, Ltd., Orwell Works, Ipswich. 6237 A

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APPLICATIONS are INVITED for the POSITION of ASSISTANT MACHINE SHOP FOREMAN for small works on North-East Coast. The man appointed will be responsible for Inspection, the Design of Jigs and Tools, and the Maintenance of Machines. Only men experienced in Gear Cutting Machines and Inspection of Gearing need apply.—Write, stating age, experience, salary required, 6133, The Engineer Office. 6133 A

ENGINEER REQUIRED.—Capable Working FOREMAN, thoroughly trained at the bench and with a good working knowledge of electric motors, dynamos, and lighting; steam plant, Lancashire boilers, &c. Age between 30 and 40. No previous experience in the brewing trade required.—Apply, in writing only, NICHOLSON and SONS, Ltd., Brewers, Maidenhead. P3508 A

FOUNDRY FOREMAN REQUIRED for Midlands. General Engineering Work, Loam and Sand; good organiser, strong disciplinarian, and able fix rates. State age, experience, and salary.—Address, 6225, The Engineer Office. 6225 A

SITUATIONS WANTED

WANTED, ARTICLED APPRENTICESHIP under A.M.I.C.E., for two Indian students up to Inter. B.Sc. standard. State premiums required.—Please write PRINCIPAL, Chambers College, 335, High Holborn, London, W.C. 1. P3510 B

COMMERCIAL MANAGER, with 20 Years' Experience buying and selling engineering and manufactured goods, London and New York, DESIRES POST or AGENCY for high-class firm or goods. Own car for travelling.—W. G. S., 126, Sussex-road, Harrow. P3504 B

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GENTLEMAN, 29 Years in the Engineering Trade, DESIRES to JOINTLY REPRESENT one or two firms in Lincolnshire and Eastern Counties.—Address, P3509, The Engineer Office. P3509 B

MECH. and ELECT. ENGINEER, Long Experience as engineer and manager, factory equipment, maintenance, mass production or otherwise, male and female labour, SEEKS SITUATION. Speaks German fairly well.—Address, P3511, The Engineer Office. P3511 B

YOUNG MAN, College and Pupilage (Railway) trained, SEEKS POSITION in Civil Engineer's Office; would accept low salary to commence; good references; free now.—Address, P3505, The Engineer Office. P3505 B

FOREMAN, 20 Years' Experience, Mac. Fitting and maintenance, SEEKS BERTH in any position of trust; mod. salary; London.—Address, P3501, The Engineer Office. P3501 B

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ADVERTISER WANTS PARTNERSHIP in a Well-established Land Agency Office in London or country, where country estates are managed; would invest capital and help in management. Had some experience in land agency work and mineral properties.—Address, P3506, The Engineer Office. P3506 C

AN Experienced ENGINEER, a Man of Affairs, action and status, SEEKS ADMINISTRATIVE POSITION (London) in trade or profession at nominal remuneration for a period, with view to permanency. Present office at good address could be retained. Inquiries per solicitor preferred.—Address, P3503, The Engineer Office. P3503 C

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Wages in the Shipbuilding Trades.

ON Friday last, August 5th, Mr. John Barr presided over a joint London conference between the Shipbuilding Employers' Federation and the Federation of Engineering and Shipbuilding Trades, at which the application of the men's unions for an advance of 10s. a week and a corresponding increase in the piece rates was again discussed. The employers, who had reviewed the position of the industry since the meeting held a month earlier, explained that for economical reasons the payment of increased wages was not warranted. Work on hand, it was stated, had been taken at prices which did not cover costs and charges, and it had been found impossible to obtain orders at such prices as would allow for the increase in wages proposed. As the question under consideration was one of fact rather than opinion, it was not felt by the employers that the subject under discussion was one suitable for settlement by arbitration. The suggestion which had been made by the employers on several occasions since 1924 was again put forward, namely, that both parties should sit down and jointly hammer out a definite index for the automatic regulation of wages in accordance with the ability of the industry to pay. Such an index, if it could be found, would, it was pointed out, convert the whole question of wages into one of simple ascertainment for the industry as a whole, which could be based on knowledge available to both parties. This proposal is now being considered by the unions. At a subsequent meeting it was agreed that the Shipbuilding Employers' Federation should meet representatives of the Boilermakers' Society to-day, Friday, August 12th, in order to discuss the situation arising out of the unofficial strike of riveters in the Clyde area, which was referred to in our Journal note of last week.

Safety in Mines Research.

THE recently issued fifth annual report of the Safety in Mines Research Board shows that satisfactory progress was made during 1926 in all branches in which research work has been undertaken. Such work has been carried out, and is still in progress, on the ignition of coal dust and on the propagation of explosions, in the new 4ft. gallery at Buxton. It has been found by using several different coal dusts that for every 1 per cent. of fire-damp in the air about 5 per cent. more incombustible dust is required to render the mixture incapable of propagating flame than when the air is free of gas. In the work done on fire-damp explosions satisfactory information has been obtained on the factors upon which the ignition and the propagation of flame depend. Various aspects of the problem of the spontaneous combustion of coal have been studied, including the behaviour of gob fires behind stoppings. Flame-proof electrical machinery has been submitted to tests and the pressures caused by the blowing of fuses within fuse boxes, and the striking and maintenance of arcs within flame-proof enclosures, have been investigated. Other work mentioned in the report includes the testing of mining explosives and the efficiency of electric safety lamps. Various mechanical appliances submitted by inventors have been reported upon, and an investigation on the winning of coal without explosives, in which pneumatic hammers are used for driving in the wedges to bring down the coal, has been continued. Extensive work has been done on falls of ground and the means for their prevention by proper timbering. Experiments have also been made on life of wire ropes and the effect of corrosion, wear, and fatigue, while other work embraces the subjects of mine temperatures and the design of mine rescue breathing apparatus.

The New Bibby Motor Liner Cheshire.

THE new passenger liner Cheshire, which sails to-day from the Mersey on her maiden voyage to Rangoon *vid* Marseilles, Port Said and Colombo, is the latest vessel to be added to the Bibby Line fleet. She was built by the Fairfield Shipbuilding and Engineering Company, Ltd., at Govan, and has the following principal dimensions:—Length overall, 502ft.; breadth moulded, 60ft.; depth to upper deck, 36ft. 3in.; gross register, 10,500 tons. The Cheshire is a twin-screw vessel and is propelled by Fairfield-Sulzer two-cycle single-acting motors. Each engine has eight working cylinders with a diameter of 28in. and a 39in. stroke. The two engines are designed to give an output of 7700 B.H.P. at a normal speed of 110 r.p.m., which corresponds to a normal sea speed of about 15 knots. The vessel has accommodation for 275 first-class passengers and the cabins are arranged on the Bibby principle, which affords natural light and ventilation for each room. Besides passengers a considerable amount of cargo is carried, and the ship is equipped with very complete cargo-handling appliances, and refrigerating machinery is also installed. The refrigerating plant, like the deck auxiliaries, the engine-room auxiliaries, and the steering gear, is electrically operated. Current for power and lighting purposes is obtained from three Allen oil-electric generator sets. The engines are the four-cycle type and each have four cylinders with a bore of 410 mm. and a piston stroke of 600 mm. Each unit is designed to give a continuous output of 265 kW when running under tropical conditions at sea at a designed speed of 240 r.p.m. An oil-fired Cochran type boiler supplies steam for heating and galley purposes.

The Port of Southampton.

THE half-yearly report on the progress of shipping at the port of Southampton would seem to show that the extensions now being carried out by the Southern Railway and the Harbour Board are fully warranted. In the period under review there was an increase in the gross tonnage of vessels entering and leaving the Southampton docks of 1,000,000 tons over last year, and upwards of one and a-half million tons as compared with the year 1925. The total gross tonnage dealt with in the docks amounted in six months to over 14,000,000 tons, and there was an increase of 100 ships in vessels both entering and leaving the port. If the number of passengers entering the port is included with the troops arriving at Southampton during the first six months of the year, then the figure amounts to 99,459 persons, as compared with 93,108 for the year 1926 and 88,414 for the year 1925. As regards the outward-bound passenger traffic, the total number of passengers was increased by more than 16,000 in the period under review. At the end of last week the Cunarder Mauretania was dry-docked, scraped and painted in the record time of twenty-four hours, during which the hull of the ship was dry for about seventeen hours. Early this week there arrived at Southampton the three Atlantic liners Aquitania, Olympic, and Leviathan. They all left New York at the same time, and the Cunarder Aquitania reached port one hour ahead of the other two.

Electrical Export Trade.

THE growth of the British electrical export trade during the twelve months ending June last is shown by statistics recently published in *British Industries*, the official organ of the Federation of British Industries. It is estimated that over 60 per cent. of all contracts for generating plant in the world, outside of the main industrial countries, and 70 per cent. of all traction orders were placed with British manufacturers. During the first five months of this year British export shipments showed an increase of 11·5 per cent. over the corresponding period of 1926, whilst during the same period German exports showed a decline of 3 per cent., American exports were stationary, the French exports fell 24 per cent., and those of Switzerland improved by 10 per cent. On a horse-power basis British electrical exports showed an increase of 134 per cent. over the year 1920. During the first six months of the year covered by the report British firms booked contracts aggregating a higher plant capacity than those booked during the whole of 1924 and 1925. India, Australia, New Zealand, South Africa, South America, and Japan were the principal markets. Important electric railway schemes, large water power and steam super power stations, and extensive transmission and distribution schemes amounting in some cases to hundreds of thousands of pounds provided valuable contracts. In connection with main line electrification in India one firm obtained a contract for rotary converter plant valued at more than £250,000. In Europe the British electrical industry is steadily advancing, whilst in the Far East, the Straits Settlements, Africa, and Canada it has been able to strengthen its position very considerably.

The Schneider Trophy Race.

THE seaplane race for the Schneider Trophy has now been definitely fixed for September 25th, and will be run on a course near Venice. Great Britain has entered seven seaplanes and Italy will be represented by three machines, but at the time of writing particulars are not available regarding the American machines. During the past week an opportunity to inspect three of the machines was given by the Air Ministry. The seaplanes referred to have been built to the order of the Air Ministry, and will be manned by Royal Air Force pilots. They recently underwent successful flying tests at the R.A.F. stations at Calshot and Felixstowe. The machines at Calshot include the Supermarine-Napier S 5 monoplane and the Gloster-Napier IV. biplane. Both these seaplanes are equipped with Napier Lion water-cooled engines. We cannot, of course, refer to the speed of the machines or give technical particulars of the engines until after the race. The designs, it may be said, are pleasing to the eye, and two novelties include the use of wing radiators of the cooling water and a fuel tank, which is accommodated in one of the floats. A third machine is the Bristol-Short "Crusader," which has undergone her tests at Felixstowe, and is fitted with a Bristol "Mercury" air-cooled engine. It is understood that the seaplanes will shortly leave for Italy. They will be transported from Malta to Venice on H.M. Aircraft-carrier Eagle, which will be escorted by four British destroyers. Opportunity will be afforded to make several practice flights over the actual course before the race takes place. Very high speeds will without doubt be attained, and an interesting problem is presented by the difficulty of turning the seaplanes without undue loss of speed. The statement that sharp turns at high speeds cannot be made owing to their physical effects upon the pilots has been denied.

The Responsibility of Engineers in France.

A SERIOUS accident occurred on December 22nd last, at Bienod, near Pont-à-Mousson, in France, when a coke oven, which was being constructed in ferro-concrete, collapsed, causing eight deaths, besides injuries to a dozen men. As a result of the inquiry before the magistrate, two engineers employed by the Parisian firm of contractors were held responsible for the disaster. They were thereupon charged with "culpable homicide by imprudence" before the assizes, and being found guilty have just been condemned, one to three years' imprisonment and a fine of 600f., the other to two months' imprisonment and a fine bf 200f. The penalty of imprisonment was awarded, however, in each case "avec sursis," or, in other words, the prisoners have been given the benefit of a "first offenders' act," under which the penalty is suspended, and will be cancelled after a number of years if there is no subsequent conviction. The severity of the punishment is undoubted, and indeed consists as much in the publicity given to the fault of the engineers as in the satisfaction required by the law.

The Dating of Patents.

UNDER the International Convention of 1911 any person who has applied for a patent in any of the contracting countries enjoys for the purpose of registration in other contracting countries a right of priority for a period of twelve months. In the United Kingdom a patent which does not claim priority under the Convention is dated as from the date of application in this country. In nearly all other countries in the International Union no such distinction is made, all patents being dated from the day of application in the country or some later date. In 1911 and again in 1925 France proposed that the term of a patent applied for with a claim for priority under the Convention should be calculated as if it were an original patent; that is to say, without taking into account the date of the prior foreign patent on which priority was based. This proposal was rejected, but in 1925 the British delegation recommended that the matter should be investigated, and in April of the following year an *ad hoc* Committee was appointed. Its report has just been issued. It has come to the conclusion that no change is desirable in the existing British practice, but if such a change should be considered expedient, then the fixed portion of the term of the patent should begin from the date of filing of the complete specification. But such a change should not be made unless the other countries of the Convention agree to abolish "third party rights." In the United Kingdom such rights are unknown and the use of an invention by another person begun after the date of the patent can be stopped by the patentee, but in other countries a third party who exploits an invention in the interval between the application abroad and the application in that country has a "continuing right of manufacture" in that country. That is to say, to take an example, if an Englishman applies for a patent in this country and a German makes use of the invention before application for the German patent is made, he may continue to use the invention even after the German patent is secured.

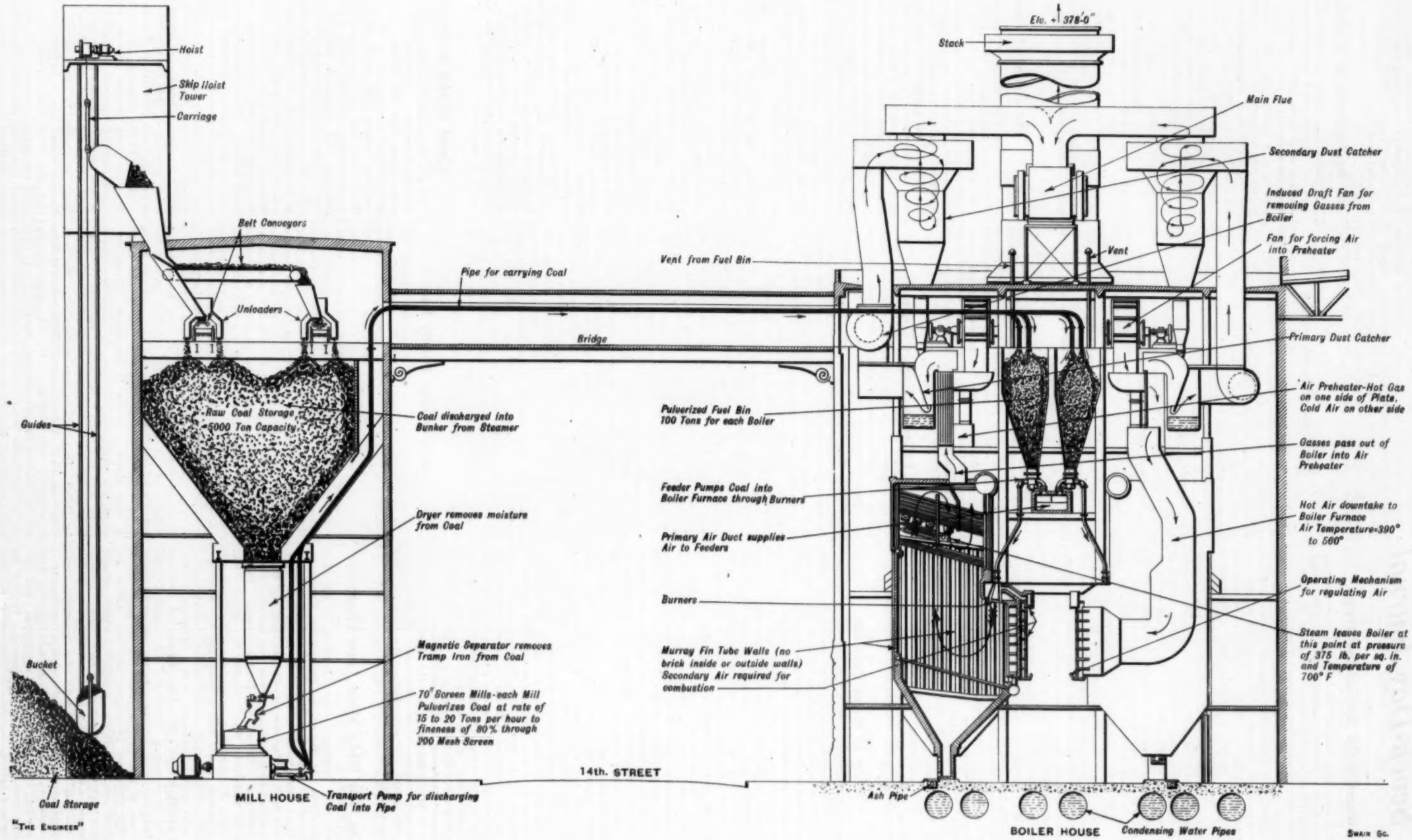
Canal Bridges in the Midlands.

IT will be recalled that the question of modernising the canal bridges in the Midland area in order to make them safe for modern traffic was recently brought into prominence by the action of a canal company, which fixed weight limits for traffic using the bridges, and held traders and others using them liable for any damage which might be done. On Saturday last representatives of the Birmingham City Council and the County Councils of Warwickshire, Worcestershire and Staffordshire met together at Birmingham to give preliminary consideration to this matter. Following a recent conference of the Midland Chambers of Commerce, the Ministry of Transport received deputations on the subject of canal bridges. It was pointed out by the Minister that his Department was simply a subsidiary Department, and it did not lie in his power to instruct either the canal company or the road authority as to what should be done. An assurance was, however, given that if a suitable scheme were prepared by the Midland local authorities, and such a scheme received the approval of the Ministry of Transport, then a grant might be given towards the cost of putting the existing canal bridges into a state which would enable them to cope with present-day traffic demands. It was further suggested that a maximum of 65 per cent. of the total cost, or a minimum of 50 per cent., might be granted by the Ministry. The remainder of the sum would have to be found by the local authorities, and there was a possibility of a contribution from the canal company. No decision was arrived at on Saturday last, and another meeting will take place shortly.

EAST RIVER STATION, NEW YORK—DIAGRAM OF FUEL PREPARING AND STEAM GENERATING EQUIPMENT

THOMAS E. MURRAY, INC., NEW YORK, CONSULTING ENGINEERS

(For description see opposite page)


Hoist
Skip Hoist Tower
Carriage
Belt Conveyors
Unloaders
Guides
Raw Coal Storage 5000 Ton Capacity
Bucket
Coal Storage
MILL HOUSE
Transport Pump for discharging Coal into Pipe
Pipe for carrying Coal
Bridge
Coal discharged into Bunker from Steamer
Dryer removes moisture from Coal
Magnetic Separator removes Tramp Iron from Coal
70" Screen Mills-each Mill Pulverizes Coal at rate of 15 to 20 Tons per hour to fineness of 80% through 200 Mesh Screen
14th. STREET
Vent from Fuel Bin
Pulverized Fuel Bin 100 Tons for each Boiler
Feeder Pumps Coal into Boiler Furnace through Burners
Primary Air Duct supplies Air to Feeders
Burners
Murray Fin Tube Walls (no brick inside or outside walls) Secondary Air required for combustion
Elv. + 378'-0"
Stack
Main Flue
Secondary Dust Catcher
Induced Draft Fan for removing Gasses from Boiler
Fan for forcing Air into Preheater
Vent
Primary Dust Catcher
Air Preheater-Hot Gas on one side of Plate, Cold Air on other side
Gasses pass out of Boiler into Air Preheater
Hot Air downtake to Boiler Furnace Air Temperature-390° to 560°
Operating Mechanism for regulating Air
Steam leaves Boiler at this point at pressure of 375 lb. per sq. in. and Temperature of 700° F
Ash Pipe
BOILER HOUSE
Condensing Water Pipes
"THE ENGINEER"
SWAIN SC.

An American Diary.

No. III.*

The East River Station.

Of the stations owned by the New York Edison Company, that which stands at the feet of East Thirteenth and East Fourteenth streets is the very latest, for it was first put into operation on November 23rd, 1926. Its primary function is to generate 25-cycle current, and it is anticipated that when it is completed its capacity will reach one million kilowatts. At present it possesses two 60,000-kW alternators, but later on units of 120,000 on one shaft may be installed. The general arrangement is rather out of the common. The block is built on a site about 200ft. wide—between two streets—and five times as long. The electrical galleries face one street and the boiler-rooms the other leaving what will be a long narrow space—about 55ft. wide and 300 yards long—for the turbine room. As even the present turbo-generators are well over 55ft. in length, they cannot be placed athwart as usual, but are set end to end along the room.

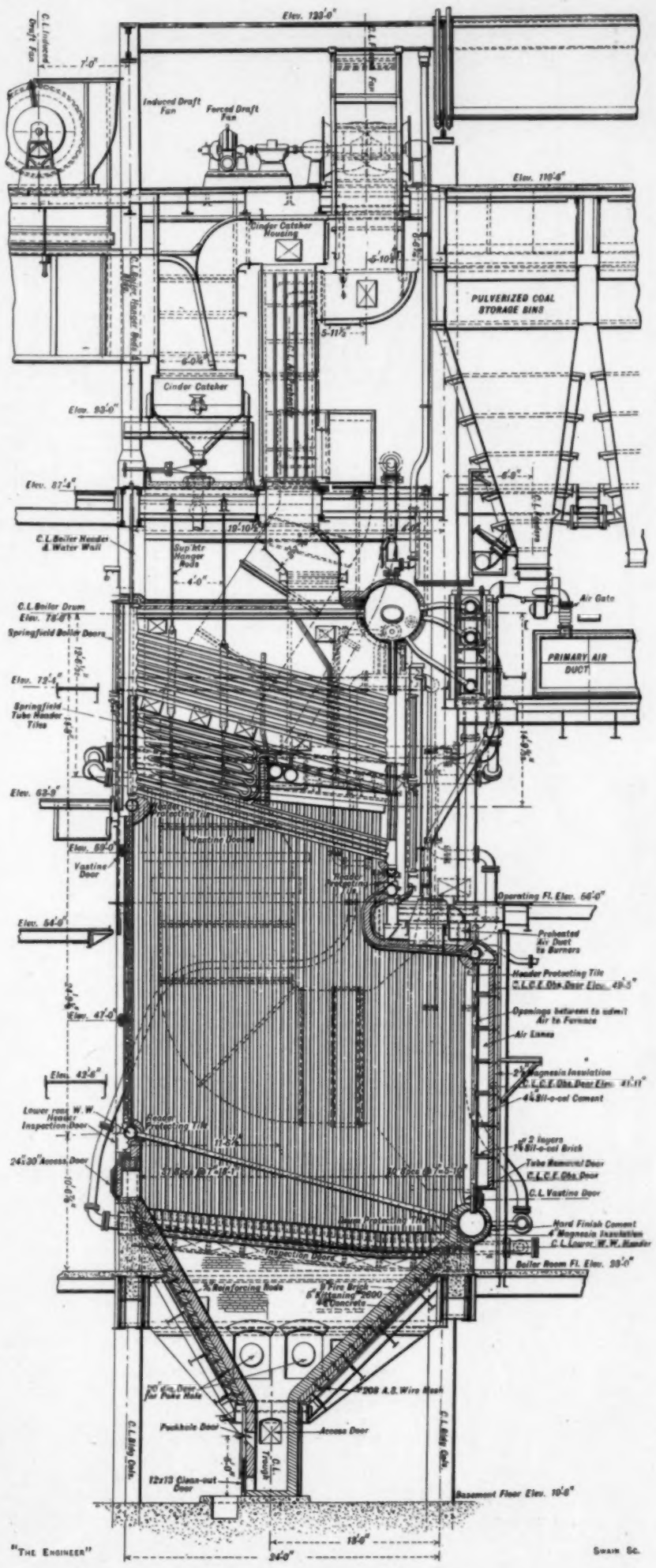
East River is a powdered fuel station and the plant for the grinding of the coal to impalpable dust is contained in a building on the other side of East Fourteenth-street, which is spanned by a bridge containing the coal pipes. This house is about 160ft. long, 60ft. wide, and, roughly, 100ft. high. Later on it will be at least twice as great. Nothing could bring home to one so forcibly the enormous addition to the boiler equipment that the use of powdered fuel involves as the sight of this large building devoted solely to the reduction of coal from lumps to powder. But that is not the end of the business. It is not sufficient to dry, grind, convey, and inject the coal into the furnace. The ashes produced in its combustion have to be dealt with. Twenty per cent. of them subside to the ashpan and can be disposed of by familiar means; but left to their own free will, the remaining 80 per cent. would ascend the stack and offend the atmosphere. It is no light matter to trap them all. Some are seized in a "wet" catcher, others are captured in Davidson cyclones, yet some escape. Furthermore, the coal dust itself is so fine that some of it finds its way through the ventilators on the bins into the air. Provision against the last is not made at East River, but it is made at other stations, as, also, is the capture of the last fugitives of the ashes. Hence we find elaborate plant at both ends of the boiler, and our wonder grows that powdered fuel should ever be economical. Yet in certain circumstances it undoubtedly is, and, as we have noticed already, the cost of preparation is far less than one would expect and the cost of the plant—per kilowatt of total plant—not nearly as great as a mere inspection of the machinery would cause one to suppose. These considerations must be borne in mind by the reader who studies the diagrammatic section through the plant which is reproduced on page 166 and notices how very small a part the actual boiler tubes occupy in the whole.

Until the 120,000-kW turbines go in, the boilers will remain the most interesting feature of this station. They are very big, being capable of producing 250,000 lb. of steam per hour, and they have, as usual, enormous combustion chambers. These chambers are entirely enclosed in Murray water walls, no brickwork or refractories being used save that the external surfaces of the tubes are covered with a thick layer of non-conducting material to reduce radiation losses. Steam is generated at 375 lb. and is superheated up to 700 deg. Fah. The boilers are of the Springfield type. Six are already in place and four more are going in. The heating surface of each is 14,809 square feet and the water walls present 4134 square feet. American engineers are still in some doubt as to how the area of fin tubes should be measured. Some take half the circumferential area of the tubes and add something for the conducting power of the fins. Others take the projected area of the furnace wall. How the measurement was made in this case we cannot say. The furnace volume above the water screen is 15,888 cubic feet. The superheater has 3430 square feet of surface and adds 257 deg. to the natural temperature of the steam, raising it to 700 deg. Fah. The air preheater, which is of the stationary steel plate kind, presents 28,900 square feet of effective surface. The chimneys are of steel, unlined. They are 22ft. in diameter and 376ft. 6in. high above the basement floor.

Statistics are as "dry" as Virginia, but a few more may give the patient reader an idea of the size of

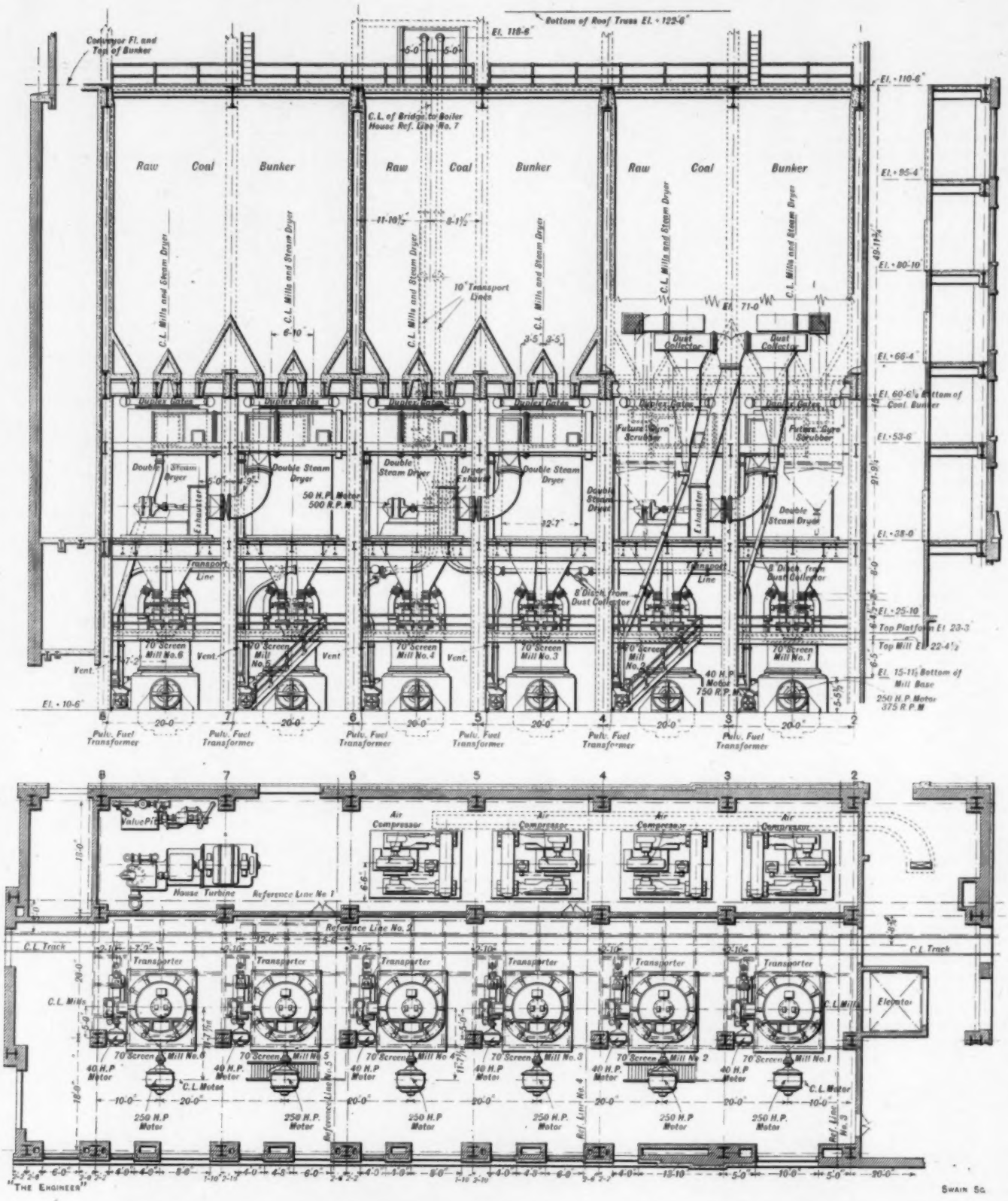
* No. II. appeared August 5th.

EAST RIVER STATION, NEW YORK



VERTICAL SECTION OF BOILER UNIT

EAST RIVER STATION, NEW YORK—THE MILL HOUSE



these boilers. Consider the draught fans, for example. Those for induced draught deliver 150,000 cubic feet of air at 8·5in. per minute, whilst the forced draught fans deliver 60,000 cubic feet per minute at 6·4in. They are driven by a 400 H.P. and a 115 H.P. steam turbine respectively, and there is one of each per boiler. In the mill house there are now six mills, each capable of pulverising 15 tons per hour and driven by a 250 H.P. motor. Then there is a blower of 24,000 cubic feet per minute capacity at a pressure of 18in., which absorbs 125 H.P. and supplies a pair of boilers. Nearly 500 H.P. per boiler is required for the preparation and burning of the coal, apart altogether from conveyors. The whole coal equipment is such an admirable example of the best practice that it seems worth while to reproduce the plan and section, even though the scale is necessarily very small.

It has already been said that the two present turbo-generators have a capacity of 60,000 kW. We may add that they run at 1500 r.p.m. and develop three-phase current at 25 cycles and 11,400 volts. The condensers are single pass and, like most American condensers, circular in section. The cooling surface is 47,500 square feet and there are two circulating pumps per condenser, each able to deliver 45,000 gallons per minute. They are driven by steam turbines of 300 H.P. running at 6270 r.p.m., and obviously must be used simultaneously when maximum power is being developed, for then something like 12,000 lb. of steam will have to be condensed per minute—some of the steam is bled away—and at 8 gallons per pound 96,000 gallons would be needed.

The Bell Laboratories of the Western Electric Company.

We have heard so much in this country of the wonderful private laboratories of the United States that an invitation to visit one of the most celebrated was welcome indeed. The laboratories of the Western Electric Company occupy a very large building; some 1500 to 1700 people are employed in "research" and about double that number in all; the separate "labs" themselves are "too numerous to mention." There is an excellent museum in which a curator who delights in his specimens will show you, admirably arranged in cases, all the inventions that mark the progress of the telephone ever since Graham Bell spoke along the wire and Dom Pedro of Brazil exclaimed "My God! it talks;" and another collection which exhibits the development of valves—which they call "tubes" in America—for the transmission and reception of wireless messages. These things and many others we saw in the laboratories, but none of them has left such an impression upon our minds as the magnificent office in which Mr. E. B. Craft, the Executive Vice-president, sits. It rises before our inward eye as we write, and we

take a firmer grip on the pen lest it should lead us into extravagances. A large room in perfect taste and admirably proportioned. Quiet in tone, breathing dignity and prosperity. A smaller room would have served Mr. Craft's turn just as well; he can only sit on one chair and write at one table; he does not have to receive delegations every day; distempered walls are just as healthy as panels, and an electric light hung untidily from a hook in the ceiling gives just as good illumination as the rarest of fittings. Is, then, the Executive Vice-president's room an extravagance? Is the impression it leaves upon the visitor valueless? That is a psychological problem into which we shall not enter. "It is nought, it is nought, saith the buyer," but when he goeth his way he rejoices that he should have dealings with a company which can afford such an "office."

And whilst we are talking of offices we may notice a not uncommon American practice which strikes the unaccustomed eye of the Englishman. In how many British offices will you find family portraits upon the walls or in frames upon the desk? In very few. We leave our families and often enough all memory of them at home when we go to work. Not so the American. Photographs of his wife and children are the *lares et penates* of his office. There is something in that, though it might be impertinent to inquire too deeply into it. It may be no more than another symbol of that domesticity which is, so it seemed to us, a characteristic of American business life. We have heard of men who refused to come to England because they could not bear to be torn away from their wives and children for a few weeks, and we have noticed on many occasions the very cordial friendship that exists between married people. There is something almost Victorian in it; something sentimental, some touch of Quality-street in it. It must not be passed over as of no account. It is perhaps one of those little indefinable things that makes for the strength of a people. Brashear, that great maker of telescope mirrors and diffraction gratings, was helped in all his work by his wife, and he was a type rather than an exception. Is it not just possible that the portraits upon the office table mean that the whole family is at one with the worker in his work. He brings symbols of his home to his office. They remind him that he is not working for himself alone, nor for his firm alone, but for a family, and by an extension of the thought for the nation as a whole.

But as the old lady with the hand-basket who won David Copperfield's caul in a raffle said, "Let us have no meandering." Let us get back to our muttons. We have said that 1500 to 1700 people are engaged upon "research" in these laboratories. That is the kind of statement that has been circulated in this country and given a wrong impression of American expenditure upon research. It needs qualification. The actual number of people occupied in researches, in the higher meaning of the word, is not more than four hundred, and of those many are doing ordinary routine work. The scientific researchers are few in number. By far the greater part of the 1500 to 1700 persons are occupied upon the development of inventions or machines. Just drawing-office or machine shop work on a somewhat higher plane than the ordinary, but not research in the sense that we use the word at all. The main difference between British and American practice is that where *we* do work of the kind in the ordinary shops, *they* set apart a special building for it. Not until the whole thing has been worked out by the laboratory does it go into the factory. There is a great deal to be said in favour of that plan in cases where it can be readily employed, but let us not be misled into dignifying it with the name of Research, which should be reserved for investigations which lead to scientific discoveries. A good case in point is the development of a combined telephone receiver and transmitter which the Western Electric Company has just brought to a successful issue. In instruments of the kind there is always a tendency for "singing" to be set up by the reciprocal action of the transmitting and receiving parts. The vibrations of one are conducted mechanically by the common grip or handle to the other and oscillations, which are persistent, are started. Combined instruments are familiar enough, but hitherto they have only been made possible by reducing the sensitiveness of one or the other part. The object sought by the Laboratory was removal of the tendency to sing without the sacrifice of efficiency. Success has been achieved by a prolonged and painstaking investigation of design, but without, we believe, the introduction of any new scientific principle.

Yet, allowing for the difference to which we have referred, a great deal of true scientific research is being pursued in these laboratories, and we peeped into many little rooms where special equipment was set up and were shown a few very beautiful experiments. Alas! that there was so little time to study them and that they should have left upon the mind only a vague impression of their purpose, though a very clear one of the zeal of the workers and a great admiration for an organisation which has the means of carrying on, and the vision to employ fruitfully, such a laboratory.

(To be continued.)

The Industrial Reconstruction of Belgium.

The position of Belgium at the close of the war was, from the material point of view, deplorable. A small highly industrialised country, with a population more dense even than that of Great Britain, its very existence depended on the prosperity of its manufactures. Four years of enemy occupation, however, had not only brought all its normal industrial life to a standstill, but had broken up the very framework of the national productiveness. The demands of the Army, coupled with the emigration of many skilled workmen and the deportation of others into Germany, had inflicted an enormous injury on the man power of the country, and with such remains of organisation as existed the Belgians had to face the reconstruction of devastated regions, ruined towns, wrecked bridges and railways and canals rendered useless by negligence or destruction. The reparation of the direct ravages of war and of such wreckage as may have been committed by the enemy on the plea of military necessity were not, however, by any means the only tasks which had to be undertaken. During the occupation the Germans had apparently acted in accordance with a deliberate policy of destruction. Their action was dictated partly perhaps by motives of "frightfulness," but no doubt largely by the intention of crippling for many years, if not for ever, those industries which rivalled their own and of reducing the country to a state of economic helplessness before their competition. So relentlessly was the destruction wrought that it is difficult to believe that it was not all part of a calculated scheme. Indeed at one large factory a book was left behind containing carefully prepared directions as to the method of doing the most vital damage to the plant. As an example of German thoroughness the case of the great Ougrée-Marihaye steel works—see The Engineer, March 14th, 1919—may be recalled. That company had the whole of its eight blast-furnaces either utterly destroyed or seriously damaged, and its steel works, acres in extent, completely wrecked. The Bessemer plant, furnaces, rolling mills, shears, cranes, engines, boilers, locomotives, and machine tools were either destroyed or carried off for erection in Germany. An idea of the completeness of the destruction will be gathered from the fact that no less than 43,900 tons of machinery and plant was actually broken up and sent away from these works in the form of scrap. The fine works of the John Cockerill Company at Seraing suffered in similar fashion (*loc. cit.*). There thousands of machines, as well as the greater part of the locomotives, wagons, travelling cranes, electric motors, and all the important items of the plant, including five blast-furnaces and nine rolling mills, were either taken away or destroyed on site. Steel works and engineering factories were not, however, the only plants which the Belgians had to build up from their ruins when their country was restored to them. The Germans included power stations also in their policy of destruction, a particularly wanton example being the blowing up of the Langerbrugge station, now famous on account of its high steam pressure. That station was wrecked by the hastily retreating armies on November 9th, 1918, two days only before the Armistice, when the end of the war was obviously imminent and the nature of the end abundantly clear.

Nearly nine years have passed since these days, and the work accomplished in the interval has been little short of marvellous. One might now visit any one of the works we have mentioned and go away having seen no evidence that it had ever been reduced to ruins or robbed of its equipment. The efforts of the Belgians, seconded by the justifiably favoured position which their nation was given in the matter of reparations, have effaced most of the traces of the painful years, though even to-day here and there one may come across reminders of the destruction, such as the broken piers of former bridges over the Gand-Terneuzen Maritime Canal. In general it may be said that the industrial rehabilitation of the country is now complete. The currency has been restored to a gold basis, the sacrifices involved being borne uncomplainingly, if not willingly, for the sake of the financial stability which they brought about.

With its industrial productiveness restored and its national finances sound, it might have been thought that the work of conscious reconstruction of the country could be halted and matters left to take their course along the natural road of slow development. Such, however, was by no means the idea of those who could influence the destinies of the nation. The success of the efforts for restoration had opened up a view of further possibilities. The King of the Belgians, always active where the welfare of his country is concerned, interested himself in the matter and in a letter which he wrote to Monsieur Jaspar, the Prime Minister, on December 7th last, he raised several points which he commended to the attention of the Government. "Are we," he asked, "proceeding along the best lines as regards facilitating rights of way for the distribution of electric power? Are we studying the principles which ought to govern the development of hydro-electric power, the economic importance of which has been demonstrated by the present coal crisis? It is indispensable that the eventual development of concessions should be examined from other aspects than that of legal formalities or local interests, and further, the problem of hydro-electric development cannot be dissociated from that of the prevention of disastrous floods. The Government ought to recognise, as you yourself do, the tendencies of to-day, and it should be the initiator of the ideas of to-morrow. In this connection I would draw your attention to an interesting speech which Mr. Baldwin made last spring, on the subject of the electrification of Great Britain. In the future, the production of electricity will be by means of large central stations, capable of realising the highest economy. Evidently the establishment of such stations will be an expensive matter, but in a little country like our own, where the industrial areas are close together, this must be the solution. The problems before us cannot be solved in their entirety for a considerable time, but they ought to be studied without delay, and with a firm intention of arriving at practical conclusions."

In accordance with this letter, the Government recommended the appointment of a "Commission Nationale des Grands Travaux," which was duly constituted by Royal Decree on March 1st this year. In making its recommendations the Cabinet pointed out that up to that time it had had to subordinate everything to the improvement of the public finances and the stabilisation of the currency. So long as there was a deficit in the Budget and the Treasury was in extreme difficulties it was impossible to undertake seriously any of the works necessary for the industrial development of the country, whatever their utility or however great their urgency. A balanced Budget and a stable currency had, however, been attained, the credit of the nation was restored, and the hour had come when in the opinion of the Government the improvement in the financial situation should be followed by an improvement in the national industrial equipment. The latter comprised a reorganisation of the waterways of the country to give the manufacturing areas, and especially the Liége district, better access to the sea, and the control of the Meuse and its tributaries with a view to the generation of hydro-electric power where possible, the improvement of navigation on the river and the avoidance of the disastrous floods which occur almost annually in the Meuse Valley. These and other works did not in general require the invention of new schemes. The Commission had rather to make a choice between various alternative proposals which had been put forward from time to time to indicate the order in which the works recommended should be carried out and to consider the financial arrangements necessary for the undertakings. The urgency of action was emphasised and the Commission was asked to bring in its report, if possible, before the month of May, so that work might be commenced at the earliest moment.

The Commission consisted of thirty-three members, including many of the most important industrialists of the country, a number of professors of engineering subjects, certain mayors of the communes affected, and Members of Parliament. It was presided over by Monsieur Emile Francqui, the man who has done so much for Belgian finances, the secretaries being Monsieur Alexander Delmer and Monsieur Léon Helbig. Neither lawyers nor politicians, as such, entered into the constitution of the Commission, the members, who gave their services freely, being chosen for their special knowledge of the matters to be dealt with. The first meeting of the Commission took place on March 22nd, when Monsieur Jaspar, the Prime Minister, charged the members with their duties. His opening speech left no doubt of the importance which the Government attached to their work. The nation, he said, had now effaced the material destructions of the war and the financial credit of the State had been restored. An immense task, however, remained to be accomplished. The Government had anxiously awaited the time to inaugurate a policy to increase the productivity of the country, and the day had now come when that work could be taken up. Just as it was the duty of private enterprise to carry on the actual work of production, so it was the duty of the Government to render conditions as favourable as possible, and to improve or create, directly or indirectly, the national equipment for industry. The Government realised its responsibility, and relied on the Commission for a programme of work. Rivers, both large and small, must be improved, and in particular the Meuse must cease to threaten by its floods the industries and inhabitants along its banks. Waterways should unite all the industrial regions and put them in communication with the ports. Further-

more, electric power generated at barrage reservoirs in the Ardennes or along the canalised Meuse should add its share to the electric equipment of the country, and the execution of these works should afford an opportunity of organising the production and transmission of power on a national scale, utilising all available sources of energy, coal, coke oven and blast-furnace gas, and falls of water. The Government considered it reasonable, even in these hard times, to undertake expensive works, provided that they would be productive, in the sense of increasing industrial facilities and developing the wealth of the country. The Commission was, however, expected to keep its sense of proportion in connection with large schemes in order that they might be in the power of the nation to carry out. Not the least part of its duties was to advise on the financing of its proposals. The whole cost could not be borne by the present generation, impoverished by the war, and it might be thought advisable to create new organisations, in which the State, the riparian communities, the municipal and provincial authorities and private enterprise should all be represented, uniting their efforts in the national object of improving the waterways and developing hydro-electric power.

At its first meeting, the Commission decided to deal with its programme by means of four sub-commissions. The sanction of the Government was obtained for this course on March 29th, and for the appointment of additional men with special qualifications to serve on the respective sub-commissions. As finally constituted, the sub-commissions were such as would command great confidence, as the Government realised that if any good were to come from their work, it was better that they should be composed mainly of men with technical knowledge or industrial experience, rather than of eminent parliamentarians or lawyers. The first sub-commission was charged with the study of the question of creating reservoirs in the Ardennes by means of barrages; the second with that of the organisation of the Meuse and Sambre in Belgian territory; the third with the question of navigation between the Meuse and Antwerp; while the fourth devoted its attention to the railway communications between Antwerp, Ghent and the principal industrial centres. Each sub-commission worked to a programme which consisted of a series of separate definite questions, and for such of these as bore upon the programme of another sub-commission joint meetings were held. As an indication of the systematic procedure of the sub-commissions, and an illustration of the practical means adopted to keep them to the point and expedite their work, the questions of the programme of the Ardennes sub-commission are worth quoting.

(1) What are, from the technical and economic points of view, the works which ought to be carried out in the Ardennes to minimise the floods in the Meuse Valley, to assure navigation to Antwerp and to produce electric energy?

(2) In what order ought these works to be carried out?

(3) What are the estimated costs of these works?

(4) To what degree will these works mitigate the floods in the Meuse Valley (this question to be examined with the second sub-commission).

(5) After the completion of these works, what quantities of water will be available for feeding a canal to Antwerp? (This question to be examined with the third sub-commission.)

(6) What are the approximate amounts of hydro-electric energy which can be produced? What will be the approximate cost of generation and the selling price? Give, if possible, approximate annual curves of available power.

(7) What will be the effect of the regulation of water flow on the pollution of the waters and on irrigation works?

(8) What should be the general plan for executing, organising and operating the installations, taking into account the following possibilities?

(*a*) Granting a concession for hydraulic power of a single watercourse, or of a number of watercourses, either to a single organisation or to a group of manufacturing firms.

(*b*) The establishment of dams and power houses in order to realise to the greatest degree the above mentioned public objects—diminution of floods, feeding of Antwerp canal, &c.—having regard at the same time to getting the greatest value from the water power available.

(*c*) The interconnection of the proposed hydro plants with thermal stations or groups of thermal stations—coke ovens and blast-furnaces—these thermal stations being either existing plants or "steam super-stations" to be constructed and provided with large generating units.

(*d*) The combination of the managements of the various interconnected stations—hydro, thermal and new super-stations—or an agreement for management in common of those stations and their interconnecting lines, so as to reduce to the strict minimum the consumption of fuel and the cost of production of the electricity sold.

The form of some of the questions reminds one of an examination paper, and that is really what the document is—a means of drawing out the expert knowledge of the men chosen to provide the answers. As a method of getting results, the procedure adopted compares very favourably with the English practice of asking witnesses to give evidence before a body the impartiality of which is assured by its ignorance of the technical points at issue. Indeed, the expedition of the work was sufficiently great to enable the complete report of the Commission to be laid before Parliament on July 13th, four and a-half months only after it was appointed, although in all about fifty sittings were required and numerous visits had to be paid to sites.

In the reports of the respective sub-commissions the questions put to the latter are separately answered, but lack of space compels us to confine ourselves to the broad outline of their findings. That, however, will be enough to show how seriously the Belgians are setting about the industrial equipment of their country, even though we must omit mention of many of the works envisaged. It has been decided to construct an entirely new canal from the Meuse at Liége to Antwerp, a distance of over 100 kiloms., capable of carrying boats of 1350 tons. The present canal communication permits only of the passage of 450-ton boats, and is encumbered with locks and other serious hindrances to navigation. It will not be long before the completion of the canalisation of the Meuse from Givet, in France, up through Dinant, Namur and Huy, to Liége, gives excellent navigation facilities to the Rhine and thence to Rotterdam by way of the Juliana Canal. To the Belgians, it would be a serious matter to see so much of their merchandise entering and leaving their country through Dutch navigable waters, and especially making use of their great rival port at Rotterdam. By starting a canal from the Meuse, just north of Liége, running by Hasselt and Herenthals to Antwerp, Belgium would keep to itself probably the whole of the Meuse traffic originating in France or Belgium, and going to or from the North Sea. The exports from the Liége district would have a good route to Antwerp, and the canal would further serve the western end of the Campine coalfield on its way. The Commission recommend that the new canal be commenced at once, work starting at both ends, and estimate that it can be completed in eight to ten years.

To find the water necessary for feeding this canal at times of low water in the Meuse, it is necessary to construct reservoirs in the Ardennes, and these are to be equipped with hydro-electric plant for the generation of power. During the rainy season these reservoirs will fill, and could be used to increase the low water flow of the Meuse by 1 cubic metre per second for every 20,000,000 cubic metres of storage capacity. Reservoirs on the Ourthe and Warche would alone enable the flow of the Meuse to be increased by 10 cubic metres per second, or sufficient to supply the needs of the projected Liége–Antwerp canal. The whole of the barrages proposed would increase the Meuse flow by 40 cubic metres per second. By means of these barrages, it is estimated that about 225 million kWh could be generated annually from the waters of the Ourthe and the Amblève, and about 500 million kWh from the Semois and its tributaries. It may be mentioned that the present production of electricity in Belgium is estimated as 3160 millions of kWh annually. As regards the price of electricity, the only projects which have been completely studied are those on the Ourthe in the neighbourhood of La Roche, and there the average cost price is estimated at 0·411d. per kWh. This power, however, would be of a valuable nature, as it could be used to supply the general system at times of peak load. Such a use would, however, naturally involve an interconnection with the thermal stations, and the utmost advantage would only be gained if there were a general organisation of electricity production on the lines recommended by the Commission. The barrage reservoirs would thus be a source of revenue to the Government, which latter, by granting concessions, would be able to regulate the flow of the Meuse and ensure the feeding of the Antwerp canal without any expenditure. Incidentally, the barrages would minimise the pollution of the Meuse at times of low water by increasing the flow, and would provide water for irrigation in the uncultivated parts of the Campine. They would also prevent the floods in the cultivated valleys of the Ardennes, but unfortunately could have little effect on the exceptional Meuse floods. Dams to prevent disasters from that cause would have to be constructed in the lower valleys of the Meuse tributaries. These would be very costly, and the Commission does not recommend them for the time being, other means being available. The Ardennes barrages and reservoirs ought, however, in their opinion, to be constructed and a law passed enabling the Government to grant concessions to private companies for the work. The scheme of concessions should be drawn up in accordance with the principle of utilising the aggregate energy available in the most economical way, and of leaving to each company the benefits of its enterprise. The interests of the public must override all other considerations, and in accordance with the Royal Commission on Monuments and Sites, the nature of the first works have been decided on with a view to the preservation of the natural beauties of the Ardennes.

With the proposed works for the prevention of floods in the Meuse Valley we have no space to deal; it must suffice to say that the replacement of the numerous existing dams by a few of considerable height, will permit the development of 130 to 180 millions of kilowatt-hours annually at a very low cost. The questions, important for Belgium, of the navigations on the Sambre and Meuse, must also be passed over. A matter, however, which is of more direct interest to engineers in this country is the organisation of a national electricity supply for Belgium. When that has been accomplished—and there is no reason to doubt that it will be—the manufacturing facilities of the country will be substantially improved. Meanwhile, it is worth noting how the Belgians have decided to deal with a problem which in many respects has its counterpart in this country.

In its material aspect the scheme consists in linking up the principal existing power stations, and connecting them with thirteen new plants to be built. The new plants would comprise six steam super-stations, with generating units of 20,000 to 50,000 kilowatt capacity. Of these stations, three would be built along the Scheldt at Antwerp, Ghent and Antoing respectively, two on the Meuse at Liége and Namur, and one on the new Antwerp–Liége canal. There would also be five stations operating on coke oven or blast-furnace gas in the metallurgical centres of Athus, Liége, Charleroi, Mons and Clabecq, and, finally, hydro-electric plants at La Roche and Amay in the Ardennes. The stations in each regional group would be connected by overhead lines or cables working at pressures up to 70,000 volts, and the groups themselves would be connected by overhead lines at pressures up to 150,000 volts. The extra high-tension transmission lines would run from Athus in the south to La Roche, Liége, Brussels, Antwerp, Ghent and Comines. Charleroi would also be connected with Ghent, *viâ* Brussels, with Liége *viâ* Amay, with La Roche, and with Valenciennes.

There is no need to repeat the familiar arguments in favour of interconnection, such as the reduction of spare plant required, the improvement in load factor, &c. With all Belgium interconnected in the manner proposed, the principle of operating the system would be to let the waste heat stations take a uniform load throughout the day; the steam stations would supply the remainder up to a certain maximum load, and the peak would be taken by the hydro plants operating for a certain number of hours. The propriety of giving the peak to the hydro plants instead of taking it on the steam stations may be questioned, but the Commission hold it to be justified on grounds of cost. It is estimated that the programme would take until 1935 to carry out, and by that time the complete system would include 1,167,000 kW of steam plant, 215,000 kW of gas plant, and 125,000 kW of hydro plant. The electricity produced would be 6950 millions of kWh annually, of which 4648 millions would be generated by steam, 1887 millions by waste heat and 415 millions by water power. With the same coal consumption as at present, the production of electricity would be doubled, the labour required would be reduced from 12,000 to 10,500 men, and the cost price of electricity would be reduced from 40 to 25 centimes (0·548d. to 0·343d.) per kWh. The programme would require, during the period 1927–1935, the expenditure of about 30 million pounds, of which half would be derived from the sinking funds of existing installations. The remaining 15 million pounds would be provided by fresh money. It may be remarked that, according to the estimates of the Commission, this fresh capital would be less than that required by the existing electricity undertakings during the period in question, assuming them to continue their independent operations.

Most interesting of all is, perhaps, the means by which the Commission has recommended the reorganisation of the electricity supply in Belgium to be brought about. It starts from the standpoint that the electrical systems of every district ought to be connected. Thus variations in the total demand for current would be minimised, and the combination of the generating plants would enable all sources of energy to be utilised with the greatest efficiency. District groupings, however, would not furnish a complete solution to the problem. The greater the area the more effective would be the diversity factor, so that the districts themselves ought to be interconnected in order that electricity might be exchanged between them according to their necessities at any time. A national organisation is also of the more importance in that it would facilitate the interchange of energy with neighbouring countries, a form of international trade which is likely to become of significance with the improvements in electrical transmission and the large works projected on the other side of the frontiers. The amalgamation of existing undertakings is not considered a practicable solution of the district or national unification of the electricity supply, for the nature of the undertakings is too varied and the interests too divergent. Furthermore, the concentration of electrical enterprise in this manner would result in a form of monopoly which would be contrary to the interests of consumers.

Without going so far as the creation of an electricity trust, it is considered that the advantages of the operation of the plants in parallel could be obtained by the constitution in each district of a society for the realisation of that object. A district society would include all the producers of electricity who could bring any advantage to the community by reason of the nature or the importance of their installations, and it would equally include all consumers taking normally more than 1000 kW. Provincial and muni-

cipal authorities and the National Railway Company would also be invited to join. The societies should be as representative in their composition as possible. The electricity producers connected with them would retain their independence so far as concerned the supply of current for their own needs and for those of their customers. They would, however, put at the disposal of the society all their excess power, temporary or permanent. Such current would be furnished at cost price, the profits after paying interest on capital would be credited to the participants in the scheme in such a way that each would have an interest in the most efficient utilisation of all the plant concerned. The organisation of the societies, the sharing of profits, and the question of management and operation have been the subject of very careful consideration, and the conclusions of the Commission are supported by the results of several years of successful experience of co-operative electricity production in the Liége district.

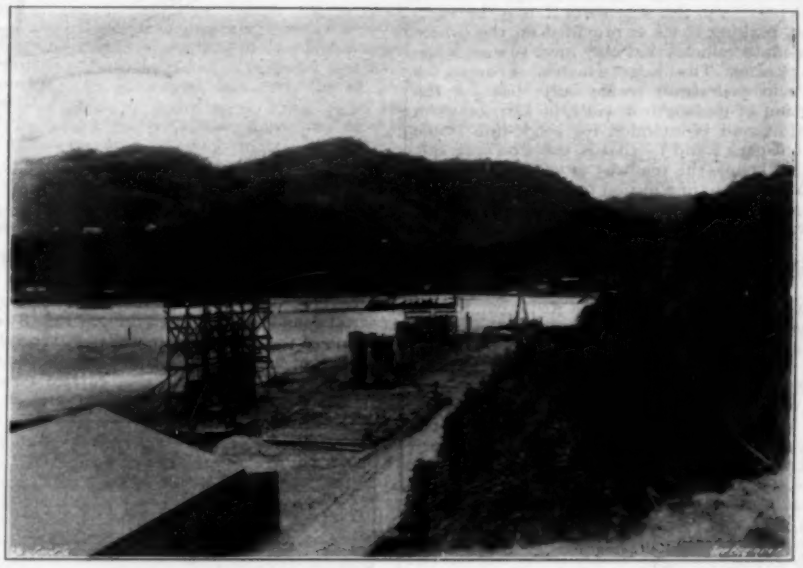
The district societies, which between them would cover the whole of the country, would be federated into an organisation to be called the Belgian Electricity Union. This body would do for its component societies what the latter would do for the electricity producers in their areas, namely, regulate the transmission of electricity from one district to another, so that all the electricity needed was generated where it could be most economically produced. Carried out to its logical conclusion, the scheme of the Commissioners would result in every producer of electricity feeding power into or withdrawing it from a common system. Whether any particular plant should supply power to the system or not would be apparently decided by the district society, which, according to the recommendations of the Sub-Commission, would have the power to dictate as to what generating units in the district should be operated at any particular hour. The main Commission does not seem to be willing to go quite so far as that, but apparently hopes that the prices of electricity could be so adjusted that the interests of every producer would be identical with those of the society as a whole. Thus, whatever the capacity of a particular generating plant might be, the owner would have no incentive to use it either for his own power or to supply power to others unless it was economically right that it should be so used. The district societies would apparently be the owners of the transmission lines and sub-stations required for interconnecting the producers of electricity in their respective areas, while the main transmission system linking up the districts one with another would be owned and operated by the Belgian Electricity Union. The latter would decide whether any given district should be a seller or purchaser of power and would effect the interchanges required by its decisions.

It will be very interesting to English engineers to see how the Belgian scheme for co-ordination of electricity supply works out in practice, for the way the Belgians have gone about the business leaves little doubt that the recommendations of their Commission will be acted on without any waste of time. It will be noted that the organisation of their electricity supply is kept entirely in the hands of the parties interested. The district societies, formed of important consumers and suppliers, would appear to have absolute powers within their areas, with no one to dictate to them except the National Union composed of representatives of themselves. There is therefore nothing in the nature of a group of permanent officials appointed by the Government endeavouring to impose their ideas on people who think they know better. The scheme is a thoroughly democratic one, with apparently no loophole for bureaucracy to enter. Those interested in the production and use of electricity are to make their own bed, and if they do not find it comfortable they will have no one to blame but themselves. That the results will be sound technically there is no reason whatever to doubt. One of the existing Belgian stations already leads the world with regard to steam temperatures and Europe with regard to pressures, and with the enterprise of her individual engineers organised for a common end, Belgium may teach equally striking lessons in respect of electricity production.

The Mokau Bridge, Taranaki, New Zealand.

An interesting bridge, which is to link together the provinces of Taranaki and Auckland, in New Zealand, and to remove the final obstacle to continuous traffic on the Main North Road—an out-of-date ferry across the river Mokau—has been in course of construction since May, 1925, and, despite the fact that all sorts of delays have been experienced, it is generally conceded that the progress made with it has been satisfactory. First, there was the strike "At Home," which delayed the arrival of the necessary supplies of reinforcing steel. Then periods of boisterous weather affected the work, and floods shifted the cylinders of the piers before they had been securely got into place, while, for practically a whole month at the end of the spring work was completely suspended owing to a succession of bad storms and floods.

With its eleven spans—two of 59ft. 7in., six of 60ft. 2in., and three of 62ft. 6in.—the bridge, without its approaches, will be nearly 700ft. in length. The longest spans are in the centre. Of the ten river piers, all but the four in the centre were, at the time this article was written, completed, as were also the two shore abutments. The latter each comprise four piles, driven down 30ft. below the river bed, with mass concrete embracing their heads. The completed piers, Nos. 2, 3 and 4 on the south side and Nos. 9, 10 and 11 on the north side, were formed on different lines. Each pier consists of two smooth-finished concrete columns linked together above the water line with mass concrete. For constructing each column, three piles were first driven close together, 30ft. into



CONSTRUCTING CONCRETE CYLINDERS FOR THE BRIDGE PIERS

the river bed, and a concrete cylinder, 5ft. in diameter, was then lowered over their heads and sunk some little distance into the bed of the river. The cylinders were then filled with concrete, and mass concrete added at the top to connect the two cylinders and complete the pier.

For the main central piers, which are to carry a lifting span to allow vessels to pass up and down the river, the method of construction was varied. For them, also, cylinders were employed, but they were of reinforced concrete, 6ft. in diameter and 21ft. long, initially, with 8in. walls, the weight of each being

LOWERING CYLINDER OVER PILES

approximately 16 tons. They were made on shore in a vertical position and the method of getting them to the river was to lower them so that they lay on their sides, to seal up their ends and to roll them into the water, in which they just floated. By means of a stage made of piles and equipped with pulleys and lifting tackle, the cylinders, when they arrived at the spot where they were to be sunk, were hoisted into a vertical position and got into correct alignment. For the operation of sinking, four jets of water from rubber hose connected up to an old-fashioned fire-engine were arranged equidistant around the base of the cylinder, and by their means the silt of the river bed was sluiced out, with the result that the cylinder gradually sank. Three-foot sections were periodically added to the top of the cylinder above the water level, as the sinking continued, the reinforcement of the new sections being screwed to that of the old, and the walls being formed by pouring concrete into an iron mould clamped to the top of the subsiding cylinder.

This "jetting-in" process took the cylinder down to a depth of some 14ft., which was as deep as the available pressure of the water jets allowed of. The piers, however, had to be founded at a depth of 30ft., and even then solid ground was not reached. As far down as 60ft. nothing save black sand and shells was found during the test borings, but the consistency was such that it was considered that half that depth would be sufficient to give a stable foundation. To get to that depth the material was excavated through the interior of the cylinder by grabs, the rims of the cylinders being built up as the latter sank. Four cylinders—for piers 5 and 6—had been sunk to the full depth when this article was written. For the other two piers, one pair of cylinders had been sunk 14ft. below river bed level, while the other two were 8ft. down. By now, doubtless, all the piers have been completed. When sunk to full depth the interiors of the cylinders were filled with concrete, and after that had set, the space separating the cylinders was filled up with mass concrete to a depth of 14ft. below the river bed.

We may say, in passing, that hydraulic jets were also used for sinking the piles, a pipe being cast in the centre of the pile and led down to the toe. The old fire-engine was also employed for this work.

The piles used for the work were of reinforced concrete, and they were all made on the site, their average length being over 40ft. The stone for making them was obtained from a quarry about 3 miles up the river. It was brought down in barges and broken up in a crusher near the site of the works. Shingle for the decking and for core fillings was obtained from the beach and was brought up by an overhead ropeway. On the south side the decking had been laid on the two spans next the approach and for that distance the bridge, except for side rails and other minor details, was complete. On the third span the boxing had been got into position ready to receive the concrete.

Girders only had been placed on the ninth and tenth spans, and none had been placed on the last span on the north or Mokau side. With the exception of the spans on each side of the lifting span—which will each have six girders—each span will have four girders spaced at equal distances apart. The smaller girders each weigh about 3 tons, but those which will join up with the piers with the lifting span will be heavier. The steel used in the girders was brought to the site by steamer from Waitara, and the girders were assembled on shore. A tram line, laid over the sand, carried them out into the river until they were practically submerged. They were then picked up by a derrick, or by a lighter, and swung into position on the bridge.

One of the most interesting features of the bridge will be the lifting span which will be of an unusual type. Unlike the remainder of the superstructure, this span, which will have a length of 62ft. 6in., will be built up of hard wood timber. To allow of the passage of vessels, the span will not be swung sideways, nor will it be hinged upwards, but it will be lifted bodily into the air. Four towers, rising vertically from the bridge deck, and braced with cross pieces, and an improved type of winch, which one man will, it is said, be able to operate by hand, will be employed for the lifting process. A system of pulleys and concrete counterweights that will almost exactly

balance the weight of the span will reduce the physical effort required to what is described as being "about that of cranking a well-behaved car." The span will be raised to such a height as to give 60ft. headroom from the water at high tide. It is to carry the heavy superstructure necessary for the satisfactory working of this lifting span that the four stouter central piers were provided. The piers on each side of the navigation channel will be heavily protected from damage by passing vessels by fenders, and the clear space left between the faces of the latter will be 50ft.

As an indication of the careful thought that was exercised in getting out the plans for this bridge, and as showing that it is anticipated that a large volume of traffic will pass over the structure, it may be mentioned that parking space is provided on the bridge to accommodate vehicles that may have to wait while a vessel is passing. The bridge, which is, of course, for vehicular and pedestrian traffic only, has for the major portion of its length a width of 12ft. between wheel guards, and is intended for single-line traffic only, but on spans 5 and 7—that is, those on each side of the lifting span—the roadway is widened to 19ft., and the extra width, in addition to providing parking space for waiting vehicles, will also serve as passing places for vehicles entering from both ends of the bridge at the same time. Gates will close the open ends while the central span is being raised and lowered.

The bridge is not level throughout its length, for the four spans on each side will rise towards the centre on a gradient of 1 in 65. The three central spans are, however, to be level. The gradients of the shoreward spans are continued in the approaches, the construction of which kept pace with the building of the bridge. Well-laid stone breastworks protect the fillings on each side from erosion by water. The south approach, which is about 4 chains long, is very nearly completed. The north approach is about a chain longer, and, on account of the sandy ground it traverses, clay was placed to a depth of 2ft. immediately inside the stone breastwork, to prevent the sand from seeping through.

Various views of the bridge are given herewith and on page 178. The panoramic view gives a good idea of the site. Other engravings illustrate the method of constructing the piers.

Recent Gale Damage at Colwyn Bay.

It is rather a curious coincidence, especially as the main cause was different in the two cases, that considerable damage has been occasioned by recent sea encroachments at two places over 30 miles apart on each side of the mouth of the Mersey, namely, at Hall-road, on the south-west Lancashire coast, 7 miles north of Liverpool, and at Colwyn Bay, the well-known North Wales seaside resort, situated midway between Chester and Holyhead.

At Hall-road the sea has been encroaching for many years, and several large houses which formerly were quite one-quarter of a mile above high-water mark and were protected by sandhills have been undermined by the action of the spring and autumn high tides, and in some cases have been actually demolished. In this case, it is generally admitted that the building of the revetment wall by the Liverpool Dock Board, some ten or twelve years ago, for improvement of the Mersey Channel, has been the direct cause of the changes in the set and scouring action of the tides upon the sand hills that line the coast there between Blundellsands and the mouth of the river Alt.

At Colwyn Bay, on the other hand, the coast erosion which has been taking place for some time is attributed to the changes in the position and depth of the sandbanks which occur at some distance from low water mark all along the North Wales coast, and the results of the recent survey of the sea bottom along this coast by an Admiralty yacht are stated to give support to this theory of the cause of the change in the tidal currents at high water.

Whatever the cause may be, there is no doubt, however, that the sea, in stormy weather, is exerting a much greater scouring action on the shingle at the base of the sea wall at high tides at the east end of Colwyn Bay than when the promenade extension was completed in the year 1897, and during the last few years many feet in depth of shingle have been removed from the sea face of the promenade wall at this point, till only a small depth of wall now remains below the level of the shingle.

The first serious damage to the wall occurred during the heavy gales of October, 1926, when 100 yards in length of the wall were displaced and broken down, the point where this damage occurred being marked A B in the accompanying sketch plan—Fig. 1. An attempt was then made to prevent further damage to the wall lying to the east of this breach, by the erection of a large number of wooden groins similar to those in use at the west end of the bay. These, however, have not been effective, for during the gale of June 25th and 26th of the present year, another section of the wall, marked C D in the sketch plan, 180 yards in length, was displaced, and a deep trench was created behind it, as shown in Fig. 2.

The repair work, which is now being taken in hand at an expenditure of many thousands of pounds, is of a two-fold character, and is being carried out by the Yorkshire Hennebique Contracting Company, of Leeds. In the case of the first breach—marked A B in the plan—where the sea wall has been entirely demolished, it is being rebuilt with much more substantial foundations and backing. Fig. 3 represents sections of the old and new walls, and it will be seen from it that whereas the old wall simply rested on the shingle, the new wall is being carried down to the blue clay, 10ft. below the surface of the shingle. Had the original wall been carried to that depth it is probable that no breaches would have been made in it. Since much of the work on the foundations can only be carried out between the tides, the work of rebuilding this section is proceeding slowly, and it will be another six months before the wall is completed.

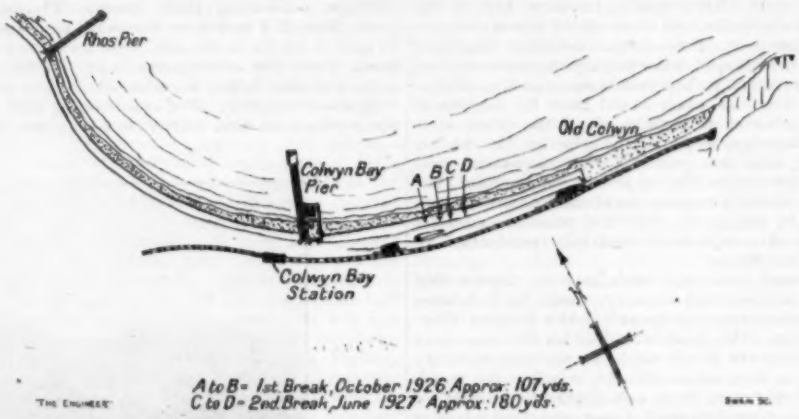

Rhos Pier
Colwyn Bay Pier
A B C D
Old Colwyn
Colwyn Bay Station
A to B = 1st Break, October 1926, Approx. 107 yds.
C to D = 2nd Break, June 1927 Approx. 180 yds.
"The Engineer"

FIG. 1—PLAN SHOWING POINTS WHERE SEA WALL HAS BEEN DAMAGED

FIG. 2—BREACH MADE BY STORM OF JUNE 25th—26th

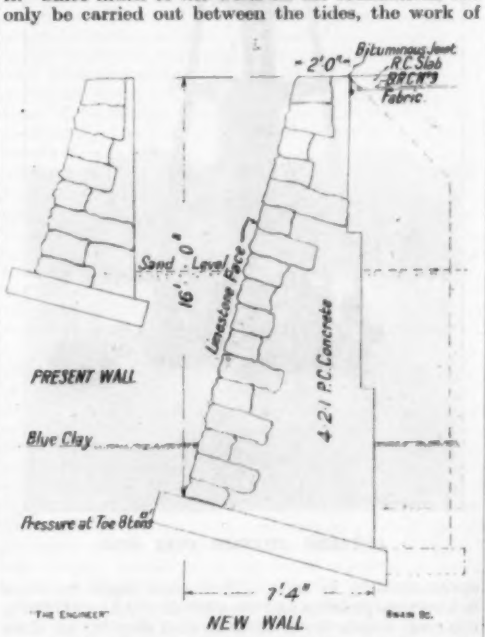


FIG. 3—SECTIONS OF OLD AND NEW WALLS

In the case of the damage caused by the storm of June 25th and 26th of the present year, an attempt is being made to prevent any further displacement of the wall by means of reinforced concrete piles driven through the shingle and into the blue clay which lies below it at the base of the wall. The piles are 10ft. in length by 18in. by 8in. in cross section, and are constructed on the Hennebique system with a metal framework core. They are made with one of the quick-hardening cements—"Ciment-fondu"—and can be employed within thirty-six hours of being moulded. Fig. 4 represents a section of one of these piles in position. The piles are driven through the shingle and red clay some distance into the blue clay below it, and the upper ends are to be keyed to the base of the wall by metal ties, and are to be protected by an apron of concrete. Since nearly 180 yards of the wall require protecting by these piles, and the work of driving them, owing to the resistance offered by the shingle and red clay, is a difficult matter, a considerable time must elapse before this section of the work is completed.

It is fortunate for the Council that the gale of Sunday morning, June 26th this year, although of great violence, was of short duration, and was not accompanied by a very high tide, for had it been otherwise this section of the promenade wall would have been completely demolished. The system of defence which is now being employed, if successful, will save the town an expenditure of between £10,000 and £20,000; but the storms of the coming winter will still be awaited with some anxiety by those responsible for the upkeep of the promenade and the sea wall, since they will prove whether this new system of defence has been able to stop further damage. Should it fail, the whole length of promenade wall at the east end of the bay for a distance of nearly three-quarters of a mile will either have to be taken down and rebuilt, or that end of the front will have to be allowed to revert to its original state of sand and shingle, and the defence against further encroachment left to the London, Midland and Scottish Railway Company, the high embankment carrying the main line of which from Chester to Holyhead runs parallel with the promenade at this point.

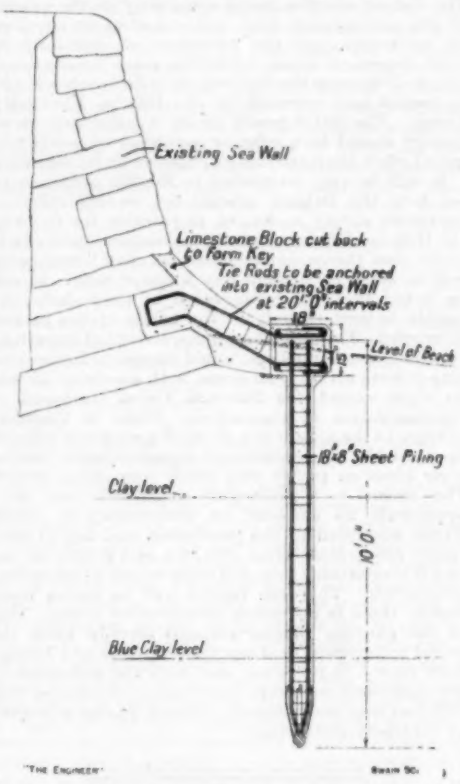


FIG. 4—REINFORCED CONCRETE PILE

Our thanks are due to the Colwyn Bay engineer and surveyor, Mr. Wm. J. Dunning, M. Inst. C.E., for assistance, and for the loan of some of the illustrations, in the preparation of this article.

Literature.

Ramsay and Donnan: Text-books of Physical Chemistry Spectroscopy. By E. C. C. BALY, C.B.E., M.Sc., F.R.S. Third edition. Vol. II. London: Longmans, Green and Co., Ltd. 1927. 18s. net.

THIS volume deals with a chapter of modern spectroscopy, which is of great general interest and of particular interest to engineers as the most exact basis of a natural system of measurement of length, viz., the methods of mensuration of the wave lengths of particular lines of the visual and ultra-violet spectra. The author has shown his readers somewhat unusual consideration by making the book self-contained by giving lucid mathematical explanations of the theory of the various instruments and methods of mensuration described. As a matter of fact, the whole volume, in spite of its bulk, treats such an apparently small part of spectroscopy as the Newton ring phenomena used for exact mensuration in modern interferometers, of which those by Michelson and Fabry and Perot are discussed in detail. The former method uses the two glass plates of the Newton ring apparatus a considerable distance apart at right angles to each other, and silvered to act as reflectors, which, by means of a plane parallel glass plate at 45 deg. angle to both, cause two interference pencils of light from a definite spectrum line to enter a telescope for observation. Points of maximum visibility of the rings are observed, when one of the reflectors is displaced parallel with itself through a distance P, the recurrences having a certain relationship to the wave length of the light under examination. Fabry and Perot employ Newton's original arrangement, but enhance the effect by slightly silvering the inner surfaces of the glass plates, and, like Michelson, they employ fairly large distances. Their observations are mainly direct comparisons between two sets of interference lines, one set being used as a standard, periods of coincidence being employed for calculating the wave lengths. The author calls the lines of interference "fringes" for some reason or another; maybe to emphasise that they are magnified parts of a circle. As standards of wave lengths, the red, green and blue lines of the cadmium spectrum are employed. Fabry and Perot's standard air gap "étalons" are also described, as well as their apparatus with variable and measurable distances between the plates. The discussion of the influence of angular deviations from the ideal position of the various parts of the instruments is fairly complete, and sufficient to enable a careful reader to use these interferometers. With regard to practical applications, the determination of the metre in wave lengths and the determination of the diameter of planetoids and distances between twin stars, &c., are treated.

After this introductory chapter on instruments and method follows a long one on methods of illumination. This part of the book is very exhaustive, and deservedly so. The enormous dispersion of modern spectrometers necessitates an intensity and steadiness of illumination which could hardly be imagined in the early days of this branch of science. Starting with the improvements of the time-honoured Bunsen burner flame for producing luminous vapours, we come to the use of the electric resistance furnace, which not only gives high temperatures for volatilisation, but allows them to be measured. This is of great importance for stellar spectroscopy, in as far as the temperature at which certain metallic lines appear can be determined. A somewhat peculiar method, called explosion of wires, is then described. This consists in the instantaneous volatilisation of fine wires by condenser charges for observing the absorption spectra of metallic vapours. An electric arc arrangement with rotary poles is also given, which has the advantage of being an old friend to some of us, &c. &c. The mercury arc for investigation of the ultra-violet part of the spectrum is gone into at some length, and the photographic method of localising maxima of "visibility" is treated later on in the book, as are also the methods of enhancing the sensitiveness of the photographic plate within this range. In this connection, the peculiar behaviour of quartz of becoming opaque to the rays when used, and its restoration by heat treatment, &c., are described. A discussion on the behaviour of the iron lines and other details of great interest to chemists may be omitted here.

The description of the production of spark spectra in air and *vacuo* is, from a practical point of view, a masterpiece. It is refreshing to see a remark like: "It is perhaps not impertinent to point out that every induction coil has a limit beyond which it must not be pushed or the insulation will break down, and the instrument ruined" (page 113). The reviewer does not want to point out the probably accidental grammatical error, but mainly to draw attention to the sound "horse" sense of the remark. He has often wondered why some bright maker does not put an automatic cut-out or fuse in the primary of an induction coil. That the author points out that the induction coil is not "the most efficient instrument possible" is another truism, though he evidently forgets that a step-up transformer can be worked with batteries and a mechanical interrupter. The various forms of apparatus for holding the poles of the spark gap are somewhat "professorial," i.e., either too elaborate and costly or too primitive and frail. In connection with spark spectra of solutions, there is a chapter on quantitative analysis based on the relative persistence of the various metallic lines with dilution. Although the method is very elaborate, when a great number of lines has to be observed and disappearances at various dilutions have to be noted, there may be cases where such a method may be permissible on account of the small amount of substance necessary. Rare and unique coins and ornaments, &c., can be analysed by a small amount of "sweating" with acid, and the additions characteristic of alloy steels can be determined by this means. At the moment the whole thing is more or less of a curiosity, but it is impossible to foretell what it may become in future. In the few purely analytical laboratories, where an ancient spectroscope is to be seen, it generally serves the same purpose as the stuffed crocodiles of the alchemists, viz., to mystify the uninitiated. Physical methods are used mainly to save time, and even the simple comparison of photographs of spectra suggested by de Gramont would involve a new departure of disturbing nature in the ordinary analytical routine, which admits the use of centrifugal machines, polariscopes, hydrometers, &c., that require no mental exertion for the interpretation of results.

This by the way; the following part of the book treating the spectra of gases and various forms of vacuum tubes is fairly condensed, as are the notes on cathode luminescence, &c. The author has wisely confined his attention to the forms of illumination compatible with the use of the interferometers; hence, some further notes on fluorescence and phosphorescence complete that part with a chapter interposed on the nature of spectra as deduced from the results of resolving and measuring separate lines as to wave length and width, &c. To most readers the final notes on photographic novelties and improvements will be of great interest.

In trying to form an idea about the general impression created by a perusal of this book, the reviewer was struck by the great attention paid to the pedagogical side—*faute de mieux*—of all demonstrations, *i.e.*, the author wisely assumes that the subject is new to the reader, and he carefully explains the meaning of the various signs used in the formulæ. There are some exceptions in the demonstration of the theory of Michelson's method, where an illustration showing the various angular quantities might be useful on page 4 to indicate that there is a lengthening of path with successive reflections causing the recurrence of extinction by interference in the well-known way. Some misprints like "metres" for "μ" at the top of page 11 might also be corrected. Still, taken all round this book, like some others appearing of late, shows another step towards the emancipation of the English text-book literature on applied science, which will eventually make students independent of French and German works of the kind. The author is to be congratulated upon treating the practical side of his subject with that loving care which most others reserve for the purely theoretical speculations. Most of the advances in our knowledge on his subject have sprung from the high degrees of accuracy obtainable with modern instruments, and he has devoted a book to two of them with accessories, a rather unusual kind of self-denial. One can only look forward to the pleasure of seeing the continuation with keen anticipation.

SHORT NOTICES.

Technical Report for 1926: British Engine, Boiler and Electrical Insurance Company, Ltd. Manchester. 1927. Price 7s. 6d.—The technical report of the British Engine, Boiler and Electrical Insurance Company, Ltd., for 1926, takes the usual form, and is as instructive and as interesting as in past years. It contains summary reports of the failures of mechanical and electrical machinery, and of boilers, ovens and other heating appliances, but special prominence is given to certain cases in which the accidents were attributable to segregations. In one a connecting-rod for a compressor, which was assumed to be a forging, turned out to be cast steel. At the parts where the flanges joined the web there were blowholes which were accompanied by a certain amount of segregation of impurities. Fracture occurred through this segregated area. In another case the shaft of a lift motor failed through a segregated area, but the defect seems to have been initiated by a sudden change of diameter without any appreciable fillet. In yet another case part of an hydraulic press broke owing to the metal having a bad structure. Segregations of phosphorus and other impurities were present in the metal and prevented the heat treatment from having its proper and intended effect. Amongst other failures recorded is that of a crane-hook, and it has led to the inclusion of a paper by Mr. L. W. Schuster on "The Comparison of the Stresses in Curved Beams with a Circular and Trapezoidal Section." The same author also contributes some "Notes with Regard to Stresses in the Gland Irons of Derrick Cranes," it having been found by the inspecting engineers of the company that defective design was too frequently the cause of the failure of these gland irons on derrick masts.

Modern Ignition Simply Explained. By Harold H. U. Cross. London: Crosby Lockwood and Son. 4s. net.—Much of the matter contained in this little book has already appeared in an Australian motor publication. By elaborating this matter and bringing it together in its present form the publishers have added another to the already large number of books on this subject. Whilst making no pretensions of going deeply into the details of so intricate a subject as modern magneto generator construction, or of setting forth in correct scientific sequence the various laws and principles of electro-magnetic induction, the author has succeeded in defining clearly the differences between the several systems of electric ignition in vogue; such, for instance, as the low-tension magneto, the coil, dynamo battery system, high-tension magneto, the art of timing, &c. Ignition troubles are the most common of all in motor cars, and the chapter on the care and maintenance of magnetos may be read with advantage by all car owners. The author lays special emphasis on the bad effects of dampness on the armature as well as on the condenser, and recommends means for drying the magneto. There is, however, some risk of further trouble in the average car owner "tinkering" with such parts as armature windings, and when difficulties of this nature arise we would recommend resort to the service depôts provided in most large towns by the makers of ignition apparatus.

Regulations for the Electrical Equipment of Buildings. London: F. N. Spon, Ltd. Price, bound in cloth, 1s. 6d.—Formerly this little book took the form of the well-known I.E.E. wiring rules, but with the publication of the eighth edition in 1924 its title was changed to "Regulations for the Electrical Equipment of Buildings." The first edition was published in 1882, when the book was entitled "Rules and Regulations for the Prevention of Fire Risks Arising from Electric Lighting." The second edition appeared with the same title in 1888, and the third edition in 1889, when the book was called "General Rules Recommended for Wiring for the Supply of Electrical Energy." The fourth edition appeared under the same title in 1903, whilst the three subsequent editions published in 1907, 1911 and 1916 bore the simple title of "Wiring Rules." With the publication of the eighth edition in 1924, the book took the title which it now bears. The present volume does not differ materially from the previous edition, but it contains a number of alterations that have become urgent. A tenth edition is in preparation which, with a view to simplification, may differ materially from the present volume in respect of arrangement and wording.

A Manual of Automatic Telephony. By Charles William Wilman. London: Crosby Lockwood and Son. Price 7s. 6d. net.—Most books that have been written on automatic telephony contain many complicated diagrams, which are by no means easy to follow, but the present volume deals with the subject on very simple lines. The greater part of its contents is based upon lectures delivered at the Coventry Municipal Technical Institute. The author makes no attempt to describe in detail the system of any one manufacturer, but he gives examples of the general principles involved. The examples are drawn from the step-by-step system which, owing to their adoption by the British Post Office, are of considerable value to students and those engaged in telephone work in this country. Although the book may not meet the requirements of all telephone engineers, it is by far the simplest volume on this complicated subject that has come to our notice, and we have no hesitation in recommending it to those who are about to take up the study of automatic telephony.

Domestic Electric Heating. By H. G. Solomon. London: Crosby Lockwood. Price 3s. 6d. net.—Various systems of heating houses by means of electricity are described in this volume, which the author believes to be the first book of its kind. In the opening chapter the reader is provided with general information concerning heat and the advantages of electric heating. In addition to warming rooms by means of electric radiators, &c., the volume covers domestic hot water supply, domestic electric cooking, and automatic temperature regulation. Of the innumerable designs and types of electric fires and other heating appliances on the market, only a few examples have been described, but sufficient information has been given to enable the reader to obtain a general idea of the methods in use, and the trend of electric heating. Electrical contractors and others who are engaged on work of this nature should find the volume useful.

Further Reminiscences of an Old Engineer. By A. J. G. Brisbane. 1927.—In our issue of November 12th, 1926, we gave a short notice of a little pamphlet in which "A. J. G."—Alfred Joseph Goldsmith—recalled in a very delightful manner personal engineering experiences which extended back over half a century or more. We are not surprised to learn that the many readers of that pamphlet were so pleased with its contents that they urged the author to extend it. The present pamphlet is the result. In point of time it, for an obvious reason, covers the same period as its predecessors, but the reminiscences are new and will appeal as much to the reader who likes to glance back through the years as did those in the first "volume."

BOOKS RECEIVED.

Easy Lessons in Wireless. By R. W. Hutchinson. Cambridge: University Tutorial Press, Ltd. Price 1s. 6d.

Report of the Controller of Customs and Excise for the Year 1926: Southern Rhodesia, Salisbury, Rhodesia. Printed by the Government Printer. No price stated.

Technical College, Bradford: Diploma and Special Day Courses, Session 1927–28. Bradford: Issued by the Bradford Education Committee.

Amateurs Afloat. By H. Ian MacIver. London: Hopkinson and Co., Ltd., 14, Henrietta-street, Covent Garden, W.C. 2. Price 12s. 6d. net.

Proceedings of the American Society of Civil Engineers. New York. Published by the Society, 33, West 39th-street, New York. Price 1 dollar.

Official Chemical Appointments, 1927. Sixth edition. London: The Institute of Chemistry of Great Britain and Ireland, 30, Russell-square, W.C. No price stated.

Lateral Stability, with Special Reference to Controlled Motion. By H. M. Garner (presented by the Director of Scientific Research), being No. 1077 (Ae 258) of the Reports and Memoranda of the Aeronautical Research Committee. London: H.M. Stationery Office. Price 1s. net.

Reinforced Concrete for Sewer and Conduit Works.

No. II.*

CONTINUOUS CONSTRUCTION.

The formation of sewers and conduits on the continuous system constitutes reinforced concrete work proper. It is, of course, used to a considerable extent for both pressure and gravity conduits, though in the former case, as already pointed out, pipes with special

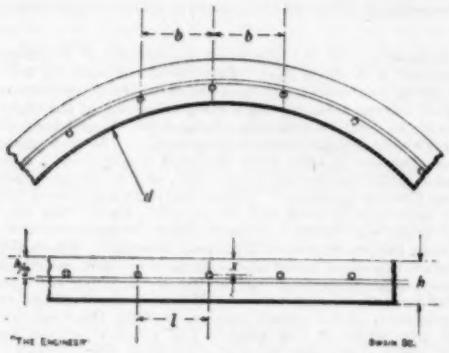


FIG. 6

joints are now regarded in many quarters as a better proposition. The "cross section," states Merriman's Civil Engineer's Handbook, "may be circular, elliptical or rectangular. Theoretically the elliptical form is best, as it corresponds more nearly to the requirements for resisting earth pressure. The circular is practically as good for small openings, while for large openings the rectangular form will often be the best

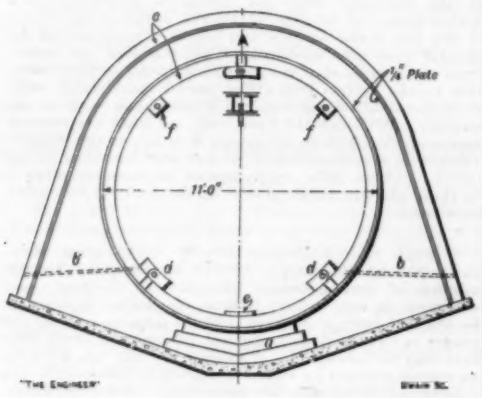


FIG. 7

on account of its simplicity and, in the case of culverts, the smaller headroom required."

ELEMENTS OF DESIGN.

Referring to Fig. 6 and considering any strip of a width b and diameter d, if p is the unit pressure on the sides and s the safe unit stress in the reinforcement, the area of steel required is given by the expression

$$a = p\,d\,b/s.$$

In order to deduce a formula from which can be ascertained the value of the percentages of reinforcement in relation to the effective thickness beyond the longitudinal bars, let A be the area of these bars l, h and x as shown on the diagram, then considering the effective thickness inside the reinforcement P the percentage referred to is equal to

$$P = A/b\,h\,(1-x)$$

and if p is the same value when the effective thickness outside the longitudinals is considered

$$p = A/b\,h\,x.$$

Values of P and p can be found by trial and error till suitable ones are obtained. As regards external pressure on gravity conduits, if the superincumbent load is equal to p on a diamcter d the total load

$$W = \tfrac{1}{4}\,p\,d.$$

If m is the ratio of the coefficients of elasticity of concrete and steel—usually taken at 15, c = a constant = 500, and A the sectional area of hooping in any length of pipe l, then if $a = l\,h$

$$\frac{p\,d}{2} = c\,[a + (m-1)\,A]$$

Again knowing h as $A = p\,l\,h$, $p = A/l\,h$. Therefore $\frac{1}{4}\,p\,d = 500\,l\,h\,(1 + 14\,p)$, from which h can be found.

CONSTRUCTION. CENTERING.

For the most part, plain round bars are used nowadays for all reinforced concrete work, and, with continuous construction, both skill and care are called for in building up the "cage" of longitudinals and circular bars and ensuring its retention in position during the placing of the concrete. Expanded metal can be used with advantage on light work or as an adjunct to the bar system on heavier work. For placing the concrete steel collapsible centering of the "Blaw" type is now extensively used, as it is superior to any form of wood shuttering for this particular purpose, bearing always in mind that the walls of reinforced concrete sewers, &c., are relatively thin, and that the reinforcement has a definite position between the inner and outer diameter to which it must be kept. It is not necessary here to describe this system of centering in detail as it is now a standardised production of the patentees, its principal feature being its collapsible property, which enables it to be taken down and set up again with great accuracy in the minimum of time.

Some rather useful information on steel centering, however, is given by Mr. W. F. Dennis[1] in describing that used on the Catskill Aqueduct of the New York water supply. Referring to Figs. 7 and 8 the former view shows the forms ready to receive the concrete, while the latter shows the inside form unit collapsed, in which condition it is moved forward on a carriage.

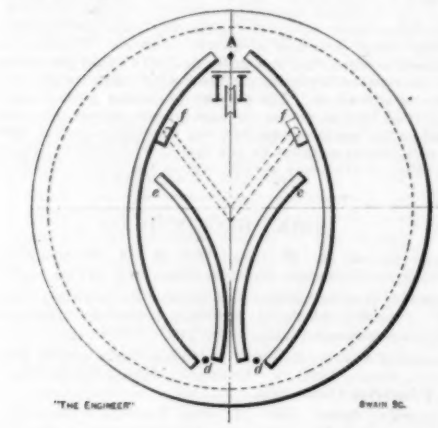


FIG. 8

It will be seen that the outside forms are adjusted on wooden blocking supported by the cradle, while the inside form is adjusted to line and grade when it comes to a proper bearing on the pillars marked a. The forms are held to proper spacing and prevented from spreading during the placing of the concrete by tapered bolts b, which are turned and polished for ease of removal. Both inside and outside forms are 7½ft. in length. The outside form has four 4in. channel

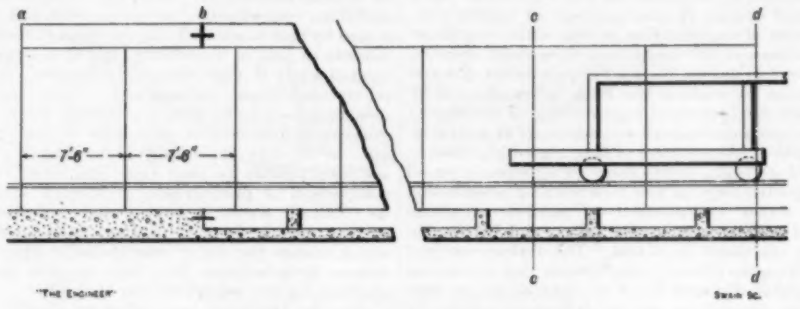


FIG. 9

iron ribs c connected longitudinally by angles all riveted to ½in. plates. These plates, however, do not cover the whole area, but are omitted at many regular intervals, for which removable doors that are placed in position from time to time as the concrete rises in the forms, are provided. The upper middle part of the form has neither plate nor doors, as the slope is flat enough to finish the concrete in the open. The hinged section of the inner forms are built with three intermediate H beam ribs and a channel at each end, quarter inch plate forming the outside cylinder of the

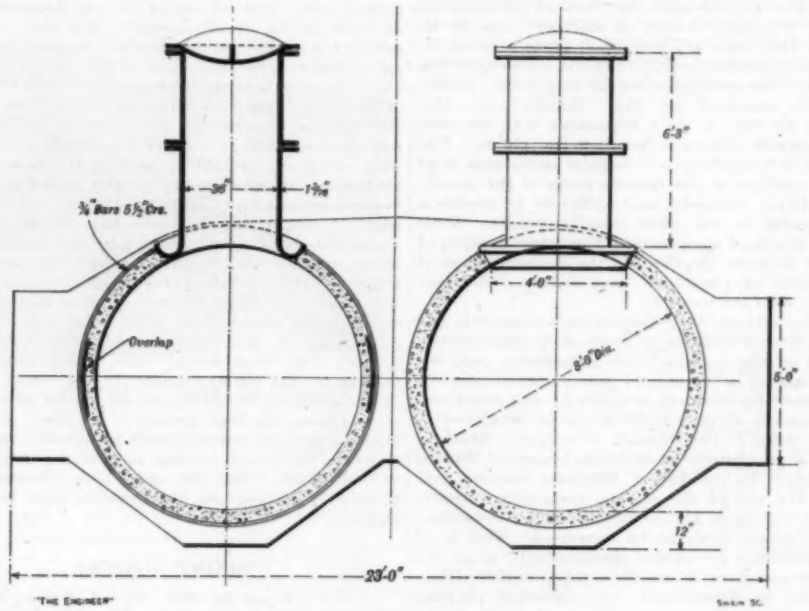


FIG. 10

form. In the channels are slotted holes to admit of slight adjustment, the units being held together lengthwise by bolts through these holes. In order to slack the inside forms, the temporary stiff connections at the hinges d and e are removed. The segments d–e are then rotated until they approach the main rib. Prior to this the cantilever beam of the carriage is

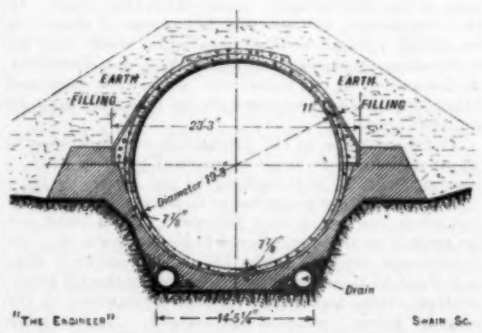


FIG. 11

advanced, the temporary arms are attached at f, and the main ribs are then drawn in and lowered to the position shown in Fig. 8. Reference to Fig. 9 indicates by a–b finished concrete supported on the forms, while b–c represents reinforcement ready to receive concrete. The plane c–c of the forward end of each

* No. I. appeared August 5th.

[1] "Trans." Inst. C.E. CXCVII.

cast is closed by a steel bulkhead held during the placing of the concrete by bolts to the outside and inside forms. This bulkhead is built up in sections including a steel expansion plate 6in. by ¼in., which forms through the bulkhead the annular tie between two casts. Inside form units are lowered to the carriage, withdrawn from the left-hand end and moved to the position indicated by *d–d*, where they are got ready for the next cast, after which the outside forms are moved into the same position by means of a travelling crane. For getting round curves steel filling pieces are used to take up the wedge-shaped space between adjacent form units.

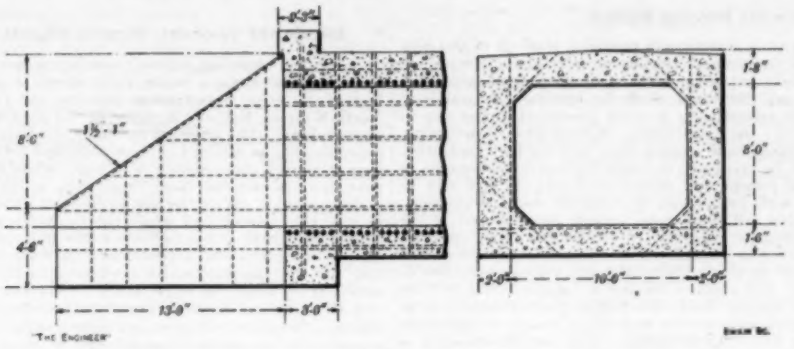


FIG. 12

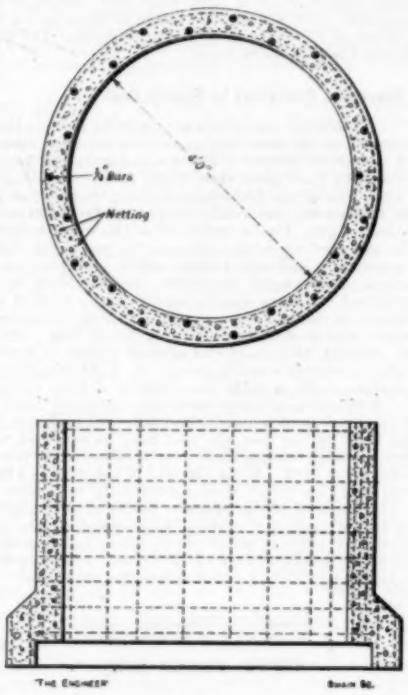


FIG. 13

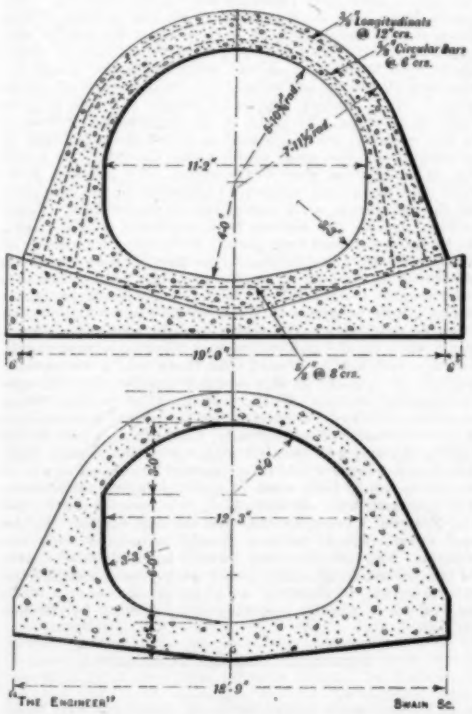


FIG. 14

RECENT CONSTRUCTION.

Amongst recent works of this class executed in this country may be mentioned the aqueduct from the Queen Mary Reservoir at Littleton, which is in the form of twin culverts 8ft. in diameter of the form shown in Fig. 10. The circumferential reinforcement consists of M.S. bars bent to form prior to being placed in position with their ends overlapping 2ft., and bent to hook shape. These hoops are spaced 5½in. apart, and have an outside diameter of 8ft. 10in. The longitudinal reinforcement consists of three ⅞in. rods at top and bottom spaced 12in. apart, the others being in the form of twisted bars of light section spaced 6in. apart and wired to the circumferentials. Space does not admit of a full description of this interesting work being given in the present instance, but it was fully described in THE ENGINEER, January 29th, 1926.

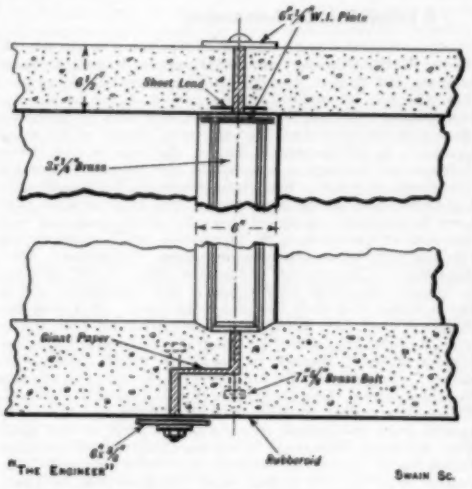


FIG. 15

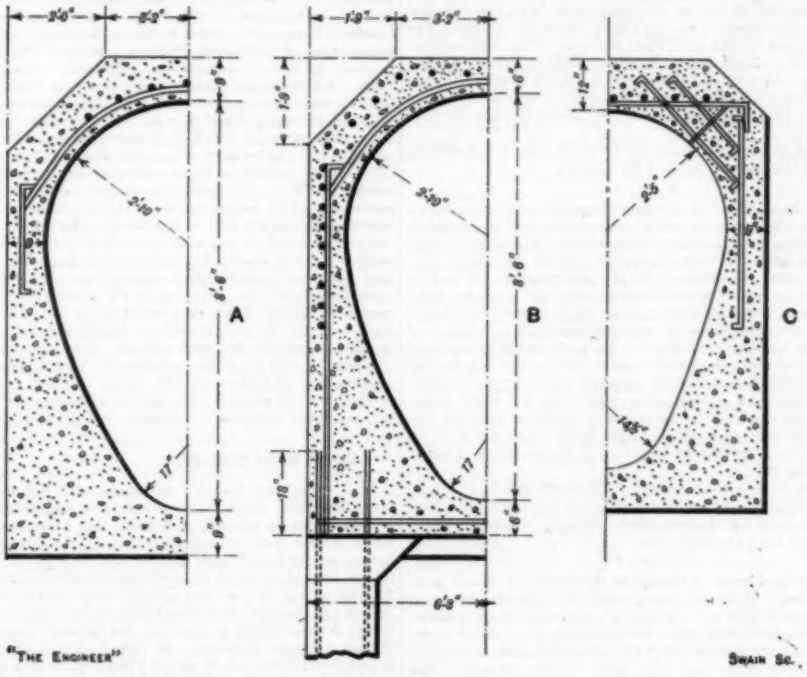


FIG. 17

Another recent example of continuous conduit work is to be seen in Drac-Romanche Works, near Grenoble. This conduit is 6 m. in diameter and it operates under a head of some 40ft. A general section is given in Fig. 11.

There are two concentric rings of reinforcing bars, which are close together at the bottom, but are separated at the crown of the pipe. Sixteen bars are used per metre length, eight for each ring. These vary in diameter from 0·55in. to 0·86in., according to the pressure. The longitudinal bars also vary with the pressure and are maximum in number at the lower end of the pipe to the extent of 135 bars of 0·47in. diameter. This work affords a good example of continuous pipe for moderate pressure laid across country.

As previously suggested, reinforced concrete proves a very suitable material for culvert and similar work in connection with railways and road construction. Take, for instance, the standardised box culverts as used on the Wabash Railroad in the United States, and described by Messrs. Mathews and Cunningham in a paper read before the Institution of Civil Engineers.[1] These culverts are used for comparatively small openings of various spans from 4ft. to 20ft. A 10ft. culvert is shown in Fig. 12.

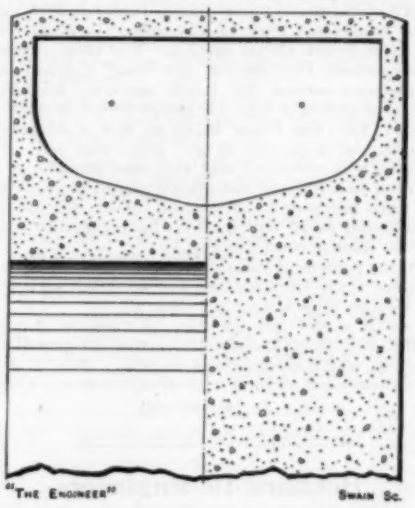


FIG. 16

The bottom slab is 18in. thick and the top slab 20in. thick, with a slight fall to the sides on top, while the walls are 24in. thick. Reinforcement in the bottom comprises longitudinal bars at 24in. crs. and transverse bars at 6in. crs., while diagonal bars are inserted at the corners as shown. The vertical bars in the walls are 24in. apart, while the top slab is reinforced in a similar manner to the bottom one except that the transverse bars are placed on the lower and not on the upper side, and the ends of alternate bars are bent up at an angle of 45 deg. for 21in. All bars are ⅞in. square. Ferro-concrete pipes for the use on the same works are made in 3ft. lengths and 2ft. to 4ft. in diameter, that shown in Fig. 13 being a 4ft. pipe. The reinforcement consists of woven wire

[1] "Trans.," Inst. C.E. CLXXXII.

fencing; a good substitute and one which might be considered preferable would be expanded metal. In the construction of the pipes inside and outside forms are used, the casing being 3in. in thickness and lined with 20-gauge galvanised iron. The pipes are as shown 4in. in thickness, and provide for 1in. of covering outside the concrete. In addition to the meshing there are ¼in. longitudinal bars at 15in. crs., the meshing being of a 4in. by 8in. diamond pattern.

Turning now to sewer work proper, ferro-concrete is essentially a suitable material for work in bad ground and for constructions which materially differ from the orthodox. Take, for example, works in connection with the Southern and Western outfall sewers, Sydney, completed within recent years,[3] which traverses a series of ridges and valleys. The sections adopted are shown in Fig. 14.

Heavily reinforced basalt concrete was used in the construction of the sewer upon a foundation of sandstone concrete. Part of the sewer is constructed with the invert above surface. For this portion a ferro-concrete box section has been adopted with foundations carried 2ft. below surface. Expansion joints, as shown in Fig. 15, are provided at intervals of 56ft. 9in., the filling being an 8–1–3 mixture of Trinidad bitumen, tallow and white coal ash. This mixture was prepared and run into moulds of the required size, the cast slabs being placed in position as the work proceeded. For some 2100ft. the sewer is constructed as an aqueduct on ferro-concrete arches of 50ft. span as shown in Fig. 16.

On the Auckland main drainage[4] there are 8½ miles of oval section sewer with an average grade of 1–3000, of which sections are given in Fig. 17.

View A shows that adopted for a length of nearly 4000ft., while view B shows the section used for 6580ft. of sewer, which is supported on piles. View C shows the arrangement of sewer in roadways near the surface.

(To be continued)

Honours to Engineers.

It will be recalled that at the recent meetings of the Institution of Naval Architects in Cambridge the degree of Doctor of Laws was conferred upon the Duke of Northumberland, Sir Archibald Denny, and Sir Eustace d'Eyncourt. The speeches on that occasion were made in Latin, which is not a familiar language to many engineers. We present therefore the following translations of them.

Few are there of British blood who do not know wherein lies the safeguard of sea empire. On the fleet depends the welfare of commerce, abundance of supplies, and the essentials of safety. But the public, which is chiefly impressed by the handling and control of ships, ascribes the skill and the credit to the gentlemen, smart in their blue clothes and "brass hats," to whom the ocean is a lake, the tempest a lullaby, and sea-sickness a thing of naught; of the inventors, the architects, the builders, it takes all too little account. To-day, our University makes amends for this popular indifference, and accords the honour of scarlet robes to the men whose science has fashioned the chief marvels of this age of genius. For the skill and ingenuity of naval architects have made such progress that if Ulysses, come to life again, were to resume his legendary voyages, and should meet a single modern ship, in astonishment at its size, its machinery, and the number of its crew, he would cease his gossip about the floating isle of Aeolus, and would pass over the rest of his adventures in silence, for all his ready tongue. Taking the hint from him, I have decided on the present occasion to say nothing of the other civil and military services of him who stands before us. It is the President of the Naval Architects that I greet.

I present to you his Grace the Duke of Northumberland, Knight of the Garter, Alan Ian Percy.

* * *

Inasmuch as ships of burthen contribute so greatly to our safety that even a short cessation of their sailings would cause a dearth of our very food, we on our part must regard the safety of our sailors as one of our chief concerns. A giver of safety is before you to-day. If a Bill is brought in for so apportioning cargo to capacity that the hull shall not sink below a line drawn along the ship's sides, in accordance with a mathematical formula; if the hollow spaces within are to be so shut off from each other by iron walls that when one is broken the others will suffice to stem the rush of the waves; if opportunity offers for entering into conventions and treaties with other countries for common measures of precaution against the common dangers of seafaring—on such occasions it is he whose advice is sought at home, it is he who is sent upon missions abroad.

I present to you the distinguished ex-President of many learned societies, the recipient of many honours, who was created baronet for his eminent services to the country, Archibald Denny, Baronet.

* * *

If a man had been in charge of the building of our warships for more than ten years, even in time of peace, we should regard him as worthy of gratitude and respect. On him who held that office for all those years while fleets were fighting for the safety of the whole Empire, we confer our highest honour this day with all our hearts. Not content with that great task, he applied his mind to new and untried methods of warfare, and was busy with gigantic machines that should sail the air; nay, the very land. How well in those functions he served not only his country, but also our Allies, is shown by the honours that France and America have bestowed upon him.

I present to you Eustace Henry William Tennyson d'Eyncourt, Knight.

[4] "Trans.," Inst. C.E. CCXII.
[3] "Trans.," Inst. C.E. CCXII.

American Engineering News.

Waterworks Pumping Stations.

Large waterworks pumping stations of the near future will have steam turbine units of about 150 million gallons daily capacity, with a direct-current generator mounted on the main shaft to operate the auxiliary machinery, according to a paper presented at the annual meeting of the American Waterworks Association. Steam turbines have already been built for high capacities, but it will be necessary to make further developments in centrifugal pumps and reduction gears. Boilers will be equipped with preheaters, economisers and superheaters, and furnaces will have water jackets forming part of the boiler circulating system. With 400 lb. gauge pressure and 255 deg. Fah. superheat, the overall duty of the pumping unit will be about 250 million foot-pounds per 1000 lb. of steam. For stations having a capacity of less than 30 million gallons daily, the future development will be towards electrically-driven centrifugal pumps, using energy purchased from central stations. An overall efficiency of 75 per cent. may be expected, as 80 to 84 per cent. have been obtained in units of 50 and 70 million gallons daily, under 170ft. head. Oil engine pumping units are believed to have but a very limited field, except in small stations where electric power is not available at satisfactory rates. But, as a matter of fact, electric power is becoming increasingly available and satisfactory. With fuel costs trending upward and electric power rates trending downward, the future development will be in the way of electric operation, except for the very large stations where steam turbine units will be economical.

A Forced Draught Locomotive.

An interesting experiment is being made on the Texas Pacific Railway, with a locomotive having a closed ashpan and forced draught delivered under the grate. The purpose is to increase the power of the engine by eliminating cylinder back pressure, and also to facilitate the use of lignite coal without the usual danger of throwing sparks. A turbine-driven fan at the side of the boiler delivers air through a conduit to the ashpan, at about 7in. gauge pressure. The grates have ½in. holes aggregating 13 per cent. of the grate area. Any additional air that may be required is supplied through a duct connected to a fire-door of special design. To provide ample capacity for the low velocity of the escaping gases, the funnel is 39in. diameter, or 25 per cent. of the tube area. To fill so large a funnel, the blast nozzle has a 9in. discharge orifice, below which is a helix coil in a 10in. pipe. An automatic stoker is used, and is adjusted to maintain an even thickness of about 2in. of fuel on the grate, as greater thickness results in the formation of banks, in which combustion ceases. Inspection holes are provided, so that the fire can be watched and the distribution of coal varied as required. There is a saving in fuel, and almost entire absence of sparks from the funnel, in spite of the kind of fuel used. But the main advantage is a gain of about 400 cylinder horse-power, due to the elimination of back pressure. The engine is of the 4–8–2 class, with cylinders 28in. by 32in., and carrying 200 lb. pressure. The heating surface is 4666 square feet; superheating surface, 1085 square feet; and grate area, 76 square feet.

Waste Incinerator.

Incineration of garbage and refuse has not met with much favour in American cities, but a large incinerating plant is being completed at Los Angeles to take care of dry rubbish and wet refuse from the markets in proportions of 65 and 35 per cent. respectively. Its capacity is the combustion of 800 tons of refuse in twenty-four hours. There are eight furnaces arranged in pairs on either side of a central driveway, reached by a ramp or incline, each pair served by a concrete chimney 100ft. high. All these are enclosed in a building 110ft. by 125ft. The furnaces are cylindrical, with dome-shaped tops, the wagons dumping directly into charging holes at the top, 4½ft. in diameter. Each unit has 68 square feet of grate area to 132 square feet of hearth, and this low proportion of grate to hearth is expected to result in a low cost of working. Nine side openings are provided for raking the contents. The combustible material alone will do the burning, no other fuel being used. The furnaces have a refractory brick lining, and an outside jacket of red brick, with a layer of insulating material between the two shells and with an outside steel casing up to the top of the cylindrical portion. Preheated air is delivered under the grates by flues. With two furnaces to each chimney, the cost is reduced and operation improved by preventing trouble from smoke and odours, since in starting one furnace it will have the advantage of hot air from the combustion chamber of the other furnace. Ashes and clinker will be deposited in an old gravel pit by means of an overhead monorail tramway with dumping tubs.

Direct Metal Castings.

Castings for the cylinders of Ford automobiles are now being made from a mixture consisting of 50 to 60 per cent. of molten iron from the blast-furnaces and 40 to 50 per cent. of cupola iron. At the furnace, 80-ton ladles are charged and deliver the iron to a hot metal mixer, like those used in open-hearth steel plants. About 25 tons of cupola iron has already been charged and about 50 tons is charged after the blast-furnace iron. From the mixer 20-ton ladles on railway trucks take charges to the 20-ton electric furnaces, in which the temperature is raised from 2000 deg. to about 2700 deg., which is the most suitable for pouring. The final stage is the tapping of the furnaces to charge 1500 lb. ladles which do the pouring. Borings pressed into blocks are melted in the cupolas, but successful experiments have been made with charging the loose borings into the spout of the electric furnace, while the hot metal from the mixer is being poured into this spout. The cupolas are 120ft. high, with 10ft. shells lined to give an interior diameter of 8ft. This unusually large size was adopted in order to allow of taking out about 25 tons every time the cupola is charged. The silicon content of the cupola iron is almost constant, so that it is easy to compensate for the varying content in the blast-furnace iron, so as to produce an iron of uniformly 1·80 per cent. silicon. Sulphur averages 0·08 per cent., but has been made as low as 0·06 per cent.

Electric and Oil-electric Shunting Engines.

For shunting railway cars on a line extending about 2 miles along a water front street to serve warehouses and other industries at Chicago, the Chicago and North-Western Railway is using 60-ton engines with oil-electric drive. The ordinary steam locomotives have been objectionable on account of their noise and smoke. Moreover, the fuel consumption was high, while the engines were in movement less than 50 per cent. of the total time in daily service. With the new engines, of which three are in use, the cost of fuel while the engine is standing is almost negligible. A six-cylinder 300 H.P. oil engine is directly connected to a generator supplying current for four 100 H.P. motors, which are geared to the four axles arranged in a pair of bogie trucks. For similar service and also for shunting mail cars at the passenger station in Chicago, the railway is using a storage battery car having a petrol-electric auxiliary which can be used to propel the locomotive or to charge the batteries. Ordinarily, the charging will be done at a power station in the usual way. The battery, with 120 cells, of 616 kW-hour capacity, can deliver 1000 H.P. to the motors. The engine is mounted on a pair of four-wheel bogie trucks, with each axle driven from a motor by a single-reduction gear. In main dimensions it is 52ft. long, 10ft. wide and 14ft. high overall, with a total wheel base of 39ft., and a tractive effort of 17,200 lb. at 10 miles per hour. The maximum speed is 30 miles an hour.

Travelling Conveyors to Handle Coal.

Handling coal in storage yards by means of grabs and conveyors on travelling gantries is common practice, but a new development is the use of gantries in series to cover a stock yard more than 650ft. wide. This is at the new gasworks of the Consolidated Gas Company, at New York, which plant has a daily output of about 120 million cubic feet of gas. Coal is delivered at the wharf in barges, and is unloaded by 6-ton grabs on the cantilever ends of two gantries or unloader bridges which span that part of the stock yard nearest the water. Behind these bridges is a third of the same length, which can be worked independently or can be lined up with either of the others to form a continuous structure about 650ft. long. On the tower carrying the wharf end of each gantry is a 60-ton bin which delivers coal by gravity to a transfer lorry on the bridge, or by a flight conveyor to a 48in. conveyor belt. Automatic trippers discharge the coal from the belts at any desired point in the yard. Or, with the third bridge lined up the rear, the coal may be delivered to its conveyor and so carried back to be discharged on the rear portion of the yard. Along the rear of the yard is a longitudinal 54in. conveyor about 1000ft. long, to deliver coal from storage into the gasworks. If the coal unloaded is to go directly into the works it is delivered by the grabs into transfer wagons, which travel along the face of the wharf and discharge it into a transverse conveyor 600ft. long, the farther end of which enters the gas house.

SIXTY YEARS AGO.

In our issue of August 9th, 1867, we printed the report submitted by Monsieur Ferdinand de Lesseps at a meeting of the Universal Company of the Suez Maritime Canal. In the course of his reports Monsieur de Lesseps referred to and quoted from an article in The Engineer as showing the change in feeling towards the undertaking which had taken place since the early days of the scheme. "We might have been their partners," we had written, "and have shared their glory as well as their advantage and material profits. But not only have we no right to share these with them; we should rather hide our heads for the part played by our great Anglo-Saxon spirit of enterprise." In a leading article we sought to make it clear that, in common with most of the engineering profession in this country, we had ceased to doubt the possibility of accomplishing the great undertaking provided the funds for its completion were forthcoming. We did not, however, and never had committed ourselves to the advocacy of the enterprise as a remunerative investment. Eight million pounds had already been expended on the works, and a resolution had been passed authorising the raising of a loan of four more millions. As part of that loan was, according to rumour, to be placed on the English market, we thought it essential to correct any misinterpretation which might be given to Monsieur de Lesseps's quotation from our columns. We felt a natural admiration for a great work boldly undertaken and vigorously prosecuted, but it could not be denied that there was a widespread volume of opinion in this country against the ultimate commercial success of the canal. The action taken originally by Lord Palmerston had prevented this country, either nationally or individually, from taking a part in the enterprise, and was open to criticism on the ground that, whether the canal would be a commercial success or not, it would certainly be a work of great political importance. The new loan was, we submitted, even more a matter for the National Exchequer than the original capital. In the end Great Britain became closely associated with the scheme. The nation to-day owns a large block of shares in the undertaking and receives each year a magnificent return by way of interest. In addition, the canal is made use of to a wholly preponderating extent by British shipping.

The Australian Government is engaging Mr. Woolnough, Professor of Geology at Sydney University, to direct investigations for the search of petroleum in that continent. He will co-operate with experts who are being engaged in England, to make an exhaustive study of possibilities of New Guinea. The Government has allocated £100,000 for these investigations.

Railway Matters.

THE British engineering profession will be glad to hear that before the Federal Court of Arbitration in June the Association of Railway Professional Officers of Australia successfully appealed against the intention of locomotive engine drivers to call themselves "locomotive engineers."

THE Great Western engine 6000, King George V., was shipped at Cardiff on the 3rd inst. for transport to the United States, where it is to be exhibited at the Railway Centenary Exhibition at Baltimore. A standard Great Western carriage and a replica of the North Star of 1837 were also sent by the same boat.

THE four lifts connecting the Charing Cross, Euston and Hampstead Station and the Baker-street and Waterloo Station with the Southern Company's main line station at Waterloo are to be supplemented by three escalators. The first of these was opened last Friday week, and it is hoped to complete the other two by October.

IT is announced that Mr. J. C. Valentine has retired from the position of divisional engineer at Darlington, London and North-Eastern Railway. That position he had held since July, 1899, when, we believe, he succeeded the late Mr. W. J. Cudworth, who went to York as chief engineer, Southern Division, North-Eastern Railway.

THAT fine railway contractor, Robert Worthington, of Dublin, would have been delighted, had he been alive, to have seen the North German Lloyd liner Luetzen put into Galway, on her way from the United States, a fortnight ago. He would have thought that there were hopes for the realisation of his dreams of Galway as a Translatlantic port.

THE 14 miles of the down line of the Great Western between Andoversford Junction and Cirencester, which were part of the Midland and South-Western Junction Railway before it was absorbed, need renewal, but as the traffic, since the amalgamation, is not considered to justify a double line, the down road is to be entirely removed. Crossing places will be provided at the intermediate stations of Withington and Foss Cross.

LOCOMOTIVE men generally will regret to hear of the retirement of Mr. F. W. Dingley, divisional chief of motive power at Crewe. That intimation has caused some of us to renew our youth as we remember old George Dingley, his grandfather, who had worked on the Grand Junction Railway, and was until his death, about 1877, foreman of the erecting shops at Crewe. In remembrance of many kindnesses shown by Mr. F. W. Dingley at accident inquiries and on occasions of unusual running of locomotives on the old London and North-Western, we wish him many years of well-earned retirement.

ANNOUNCEMENTS have recently appeared in the Press as to reductions in workmen's fares. One such notice has said that the Great Western is considering a scheme whereby a reduction of 25 per cent. is likely, and that "with railway rivalry as acute as it now is, it is practically certain that the other companies will have to follow the lead of the Great Western." What really is happening is that on the "appointed day"—January 1st next—certain fares will be reduced, and, for instance, the 6d. for 4 miles will become 5d. and the 1s. for 10 miles will be 9½d. On the other hand, some smaller rated fares will be advanced.

THE Board of Trade returns show the railway material exported during the first five months of the present year to be as follows, the corresponding figures for 1926 and 1925 being added in brackets:—Locomotives, £770,161 (£1,492,371, £1,454,201); rails, £892,334 (£991,467, £859,055); carriages, £1,246,613 (£1,032,836, £671,925); wagons, £852,046 (£1,463,146, £1,284,306); wheels and axles, £224,483 (£224,763, £246,458); tires and axles, £204,142 (£129,667, £186,378); miscellaneous permanent way, £612,931 (£499,953, £572,597); total permanent way, £2,492,931 (£2,374,900, £2,232,133). The weight of the rails exported was 107,221 tons (128,037 tons, 90,795 tons), and of the chairs and metal sleepers 43,584 tons (43,180 tons, 25,587 tons). In May last the value of the locomotives shipped overseas was £259,845, which included:—Australia, £162,202; Argentine, £23,234; other countries in South America than the Argentine, £19,506; India, £7430; South Africa, £5711; Straits Settlements, £3195. During May the value of the rails shipped was £290,927, which included:—The Argentine, £94,489; India, £84,785; New Zealand, £16,027; Ceylon, £15,244; West Africa, £4943; South Africa, £4305; Australia, £3880.

AN event to be put upon record which escaped our memory at the time, or it would have been noted earlier in our pages, is that it was ninety years on July 4th since the Grand Junction Railway was opened. At that time—July 4th, 1837—the Liverpool and Manchester Railway was opened, and there was communication thereon to Bolton and Wigan. At what is now Newton-le-Willows was the northern end of the Warrington and Newton Railway, which had been put into service on July 25th, 1831. The Great Junction joined Warrington and Birmingham, a distance of 78 miles, and was not only the most ambitious scheme contemplated at the time—1833—when it was sanctioned, but was intended to join Liverpool, Manchester, Preston, Wigan, Bolton and Warrington with Birmingham. As related in THE ENGINEER of September 12th, 1924, the Bill for its promotion met with no opposition. A yet more noteworthy feature was that the estimate of £1,500,000 was not exceeded—a fact greatly to the credit of that remarkable engineer, Joseph Locke. The London and Birmingham Railway was not sanctioned until 1834, a year after the Grand Junction was authorised. It was ninety years on July 20th since Euston and the line to Boxmoor was opened, and on October 16th next it will be ninety years since it was extended from the latter place to Tring. In contrast to Locke's successful estimate, Robert Stephenson spent twice the £2,750,000 he said the London and Birmingham would cost. But that excess was due to reasons outside Stephenson's control, *i.e.*, the line went to Euston, where was a station that cost £380,000, instead of ending at Camden; Kilsby tunnel cost £300,000, instead of £99,000; and the locomotives cost £1200 each, instead of £900.

Notes and Memoranda.

THE annual output of sulphur in Japan is estimated at 50,000 tons, about 85 per cent. of which is produced in Hokkaido.

IT is claimed that the longest continuous stretch of concrete roadway is that just finished between White Bear and Duluth, Minn., a distance of 137 miles.

A NEW synthetic resin, a pale golden yellow liquid, similar in consistency to Canada balsam, but possessing several important advantages over this substance, as a plasticiser in the cellulose lacquer industries, has, according to the *Chemical Trade Journal*, recently been put upon the market.

AT a recent meeting of the Victorian Institute of Engineers, Mr. W. R. Pollock, speaking of the Melbourne cable tramway, said that the old company, the trust, and the present board have tried various ropes, but of all tried none had proved so satisfactory as those made in Great Britain.

THE low-temperature carbonisation of coal on a commercial scale is, according to the *Iron and Coal Trades Review*, proposed for Canada. A report from Ottawa states that a syndicate is applying to Parliament for a Federal charter for a 3,000,000 dollar corporation. Plans are said to be practically complete for the construction of three high-capacity plants, one to be in Ottawa and two in Western Ontario.

IT is believed that the International Nickel Company's Frood Mine in Ontario is part of an immense deep-lying deposit of copper-nickel ore, the other part of which, known as the Frood Extension, is owned by the Mond Company. In the International Frood alone there is estimated to be 100,000,000 tons of ore, or enough at the present rate of consumption to supply the world's demands for seventy-five years. This is now being opened up by a five-compartment shaft that will be sunk to a depth of 2300ft.

A RATHER novel form of drainage pump is being installed in a coal pit in Scotland by E. N. Mackley and Co., of Gateshead. There are two turbine pumps of twelve stages each, driven by 325 horse-power motors, and capable of raising 500 gallons a minute from a depth of 1490ft. Of this amount of water 200 gallons a minute is supplied by a lodge only 930ft. down, so it is taken down to the pump by a separate pipe and, entering the casing between the fourth and fifth stages, delivers up the energy of its fall to the pump.

NEW uses are rapidly being found for "micro-asbestos," that is to say, asbestos so short in the fibre that it is useless for spinning. It forms a good filler for several kinds of paint, makes a heat insulating paste, can be turned into "stone-wood," and, with the addition of gypsum, forms a good mould lining for foundry work. The effect of heating, up to 1400°deg. Cent., on micro-asbestos, is to increase its hardness from that of clay to that of corundum. If, however, the heating be carried above 1400–1500 deg. Cent., sintering occurs.

A BRIEF description is given in a recent issue of the *Engineering News-Record* of an American dodge for planting wooden transmission poles in soft plastic soils. A length of 1¼in. pipe is driven into the ground, the soil is forced out of the bottom of the pipe, and is replaced by explosives. The pipe is withdrawn, the pole is erected over the spot and is held in position by guys or pike poles. The charge is exploded and the pole drops into the hole before the soil has time to subside again. It is said that poles as tall as 110ft. extending 14ft. to 16ft. into the ground have been set in this way.

IN describing the sinking of the Randfontein circular ventilating shaft, which is 3400ft. deep, to the South African Institution of Engineers, Mr. W. G. C. Nixon said that the winding ropes were of the Latch and Batchelor non-rotating make, 1¼in. diameter, the construction being eight strands of six wires .091in. diameter, over six strands of seven wires .081in. diameter over a triangular wire .0069 square inch area, over a core of seven wires .068in. diameter. The breaking load of these ropes was 58 tons, and these proved to be extremely dead. Mr. Nixon went down the shaft and noticed only half a turn on the bucket in 3000ft., the slight friction of the rope in the crosshead being sufficient to prevent more rotation. When the bucket left the crosshead at the sinking platform about three turns more occurred slowly before the bottom was reached, but a hand on the edge of the bucket was all that was necessary to stop all movement.

IT is noteworthy that just now considerable attention is being paid, both in America and Germany, to the embrittlement of steel by hydrogen in the process of pickling. An artile on the subject has been contributed to *Chemisch-Metallurgische Zeitschrift* by Dr.-Ing. H. Bablik, while another, in *Chemical and Metallurgical Engineering*, by Messrs. Speller and Chappell, gives some hints as to the best means of its inhibition. They find that quinoline ethiodide is the most effective, but that 1 per cent. of an acid extract of coal tar is almost as good; 1 per cent. of quinoline itself is also satisfactory—much better than 1 per cent. of pyridine. Other compounds tested and found of less marked value were glue, ethyl iodide, paramethylaminophenol sulphate, aniline, ethyl alcohol, nicotine, carbazole and ethylene chloride. Efficient works control and supervision are essential if full advantage is to be gained from the use of these inhibitors.

IN the prefatory note to Part II. of the Fuel Research Station's report on the Lancashire Ravine Seam of Coal, it is stated that it gives the results of a sequence of large scale tests carried out at H.M. Fuel Research Station on the carbonisation of this coal in continuous vertical retorts. The information obtained on the gas-making qualities of the coal has been supplemented by carrying out experiments to determine the value of the coal and the coke for steam-raising purposes, and also the suitability of the coke for water gas and suction gas production. The results obtained show the Ravine coal and coke to be well suited, as regards yields, &c., for the purposes for which they were tested. The ash of the particular consignment of coal supplied was found, in each process, to cause trouble, which may further have been increased by the critical test conditions obtaining in the plant at the Fuel Research Station. The price of the report is 1s. 6d. net.

Miscellanea.

IT is intended to construct a large coal-handling plant at Toronto Harbour.

THE Government of Victoria is to expend about £95,000 on Port Fairy harbour.

THE Delhi Municipality is expending 20 lakhs of rupees on extensions of the water supply system.

THERE are, it is officially stated, 666,000,000 dollars invested in the forest industries of Canada.

AT the present time the production of newsprint in Canada is at the rate of about 2,050,000 tons a year.

WHEN the most recent schemes have been completed there will be 2,258,000 acres of land under irrigation in Alberta.

THE Tokyo Gas Company has decided to erect two large gas holders of 4,000,000 and 2,000,000 cubic feet capacity respectively.

THE largest carbide furnace in America is being constructed at Shawingigan Falls, Quebec, by the Canada Carbide Company.

DURING the first Saturday of this month 58,163 tons of shipping was passed through the lock gates of the new Gladstone Dock, Liverpool.

THE extension of the factory of General Motors of Canada, at Oshawa, Ontario, during the present year is to cost nearly 2,000,000 dollars.

AN expenditure of over 1,500,000 dollars has been decided on for Vancouver Harbour. The greater part of the work concerns the north shore.

IT has been decided that the exhibition which is to be held in Newcastle-on-Tyne in 1929 shall take place on the Town Moor. The Moor has an area of 1200 acres.

TWO new shipping wharves are being built at Quebec, both with a depth of water of 40ft. One, at Wolfe's Cove, will be 2640ft. long, and the other, at Limorlon, 1440ft. long.

ONE new bridge over the Murray River has just been completed, and four others are now under construction. The longest one will have nine spans of 270ft. each and their total cost will be £630,000.

THE Danish Parliament has decided that the Little Belt Bridge shall carry both railway and general traffic. The new plans will be ready in four or five months, and new international tenders will then be invited.

A LARGE combine for the exploitation of electro-plating with chromium has been formed in the United States by the amalgamation of the General Chromium Corporation, the Vacuum Can Company, and certain subsidiaries of the Union Carbide and Carbon Company.

THE first consignment of Coalite produced by Low Temperature Carbonisation, Ltd., at the new Barnsley works has just been disposed of. It amounted to 500 tons, and secured a price 50 per cent. above that of best household coal. The fuel oil produced by the process is said also to be of excellent quality.

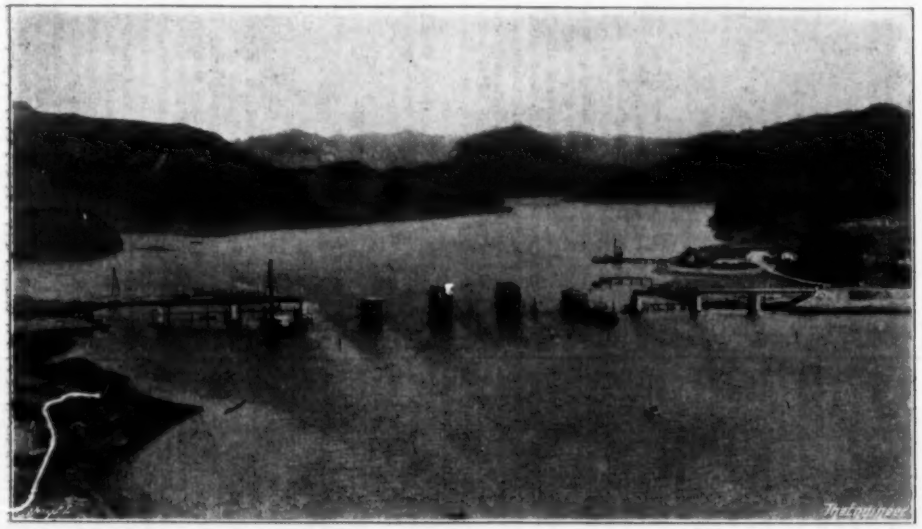
THE Government of India proposes to issue new regulations under the Indian Mines Act, the effect of which, if adopted, will be (1) to exclude women from all coal mines in Bengal, Bihar and Orissa and the Central Provinces, and the salt mines in the Punjab, by annual instalments covering a period of seven years beginning with July, 1929, and (2) to prohibit underground employment of women in all other mines as from July, 1928.

TWO slides of considerable magnitude, but without serious consequences, are reported in the *Panama Canal Record* of June 22nd, as follows:—"A portion of the west bank of Gaillard Cut, near Culebra, loosened on June 17th, and about 10,000 cubic yards of earth and rock slid towards the canal. Further movement occurred on June 20th, and as the result of both about 20,000 cubic yards of material have slipped into the canal. The 15-yard dipper dredge Gamboa has been set at removing the material from the channel. Cucaracha slide, on the other bank of the cut and directly south of Gold Hill, started to move in the night of June 19th. The entire area of the slide, about 45 acres, was involved. The slide was still moving during the morning of June 22nd, at the rate of about ½ft. per hour. About 90,000 cubic yards, mostly rock, have moved into the safety basin at the foot of the slide, with only 8000 cubic yards any interference with navigation." Later reports state that a total of 35,000 cubic yards moved in on the west side. The Cucaracha slide stopped on June 27th. During the time it was in motion, 115,000 cubic yards, mostly rock, slid into the canal; 105,000 cubic yards of this was caught in the safety basin, so that only 10,000 cubic yards reached the channel.

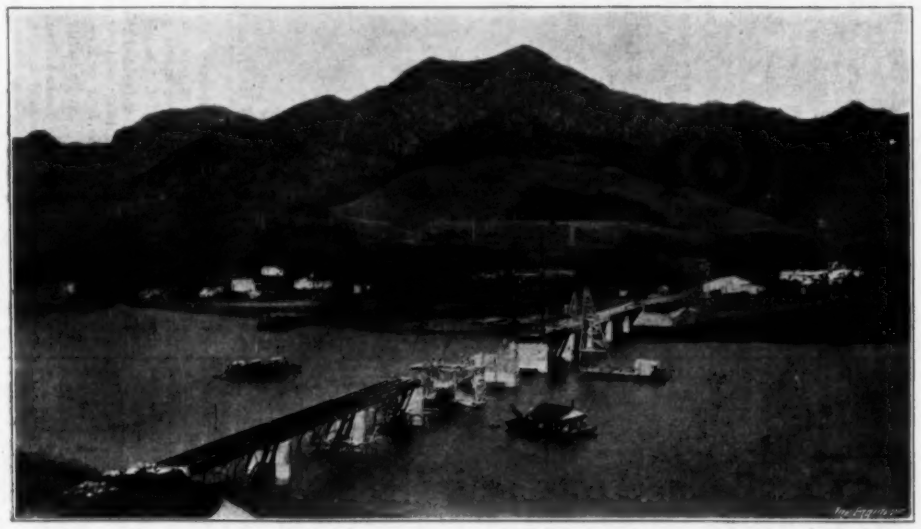
A MESSAGE from Caracas states that definite plans for far-reaching improvements have been lodged with the Government by the La Guiara Port Corporation. The present harbour works were completed in 1891. They consist of a breakwater, 500 m. in length, with three jetties adjoining, an inner basin, warehouses and other buildings; 80,000 square yards of land were reclaimed from the sea, and 10 kiloms. of railway connect with the La Guiara and Caracas railway lines. It is now proposed to lengthen the principal wharf from 15 m. to 85 m., to join up jetty No. 1—to which a railway track has been laid—with No. 2, which will allow of more steamers being berthed simultaneously, to construct 100 m. combined extension of two of the existing wharves to accommodate ships up to a capacity of 7000 tons, to build a new dock for coastwise shipping, and a reinforced concrete extension to the customs house pier. In the lighthouse a powerful rotary electric lantern and an auxiliary beacon will be installed, the pier railway will be lengthened and substantial additions made of rolling stock, electric cranes, barges and machinery. Last year La Guiara harbour receipts increased by 33 per cent., imports advancing from 94,257 tons in 1925 to 147,850 tons in 1926. The number of vessels clearing and tonnage handled rose from 566 vessels and 193,472 tons to 618 vessels and 253,381 tons. Warehouse floor area increased from 4054 square metres in 1921 to 7044 square metres in 1927.

CONSTRUCTING A BRIDGE OVER THE RIVER MOKAU, NEW ZEALAND

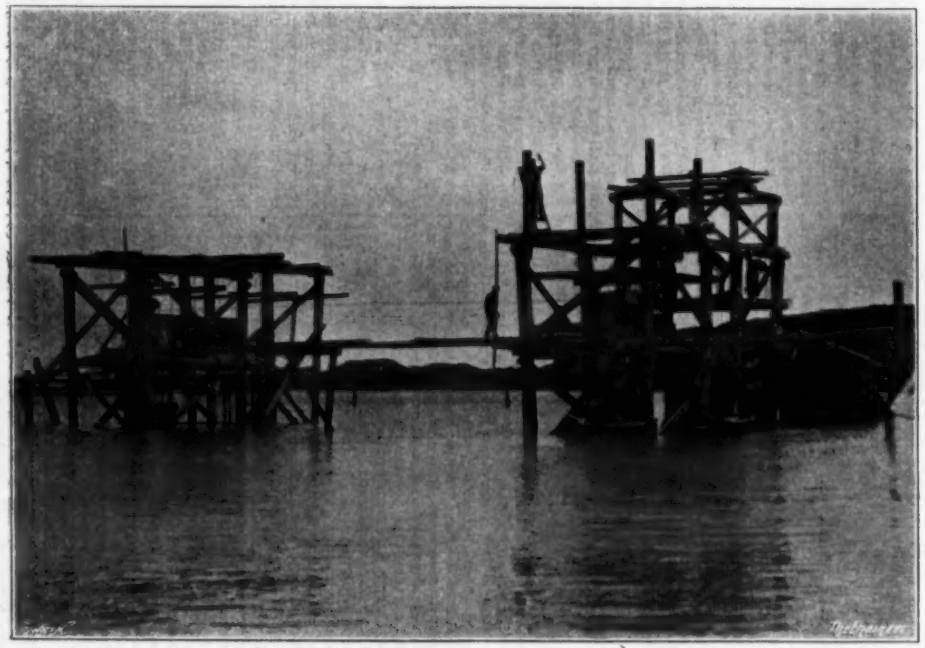
(*For description see page* 171)



PANORAMIC VIEW OF SITE OF BRIDGE



VIEW ALONG BRIDGE FROM NORTH BANK



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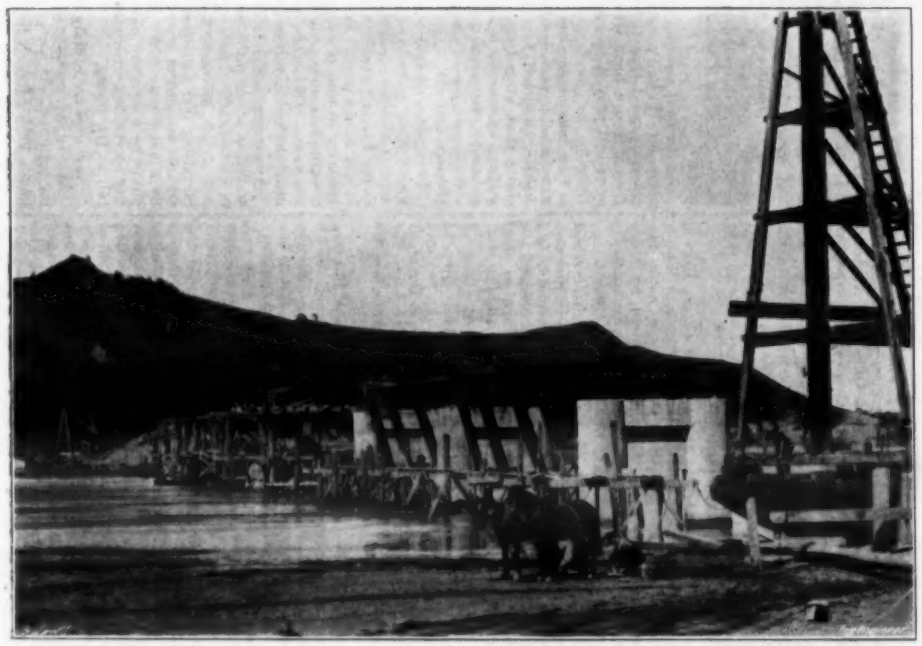

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THE ENGINEER.

AUGUST 12, 1927.

Geneva and After.

Now that the Geneva Conference on naval limitation has adjourned *sine die* without reaching agreement, there is a widespread tendency to regret that it should ever have been convened. Yet if the Conference failed in all else, at least it served the purpose of exposing to the light the fundamental questions at issue between Great Britain and the United States in the naval sphere. For years past, ever since the Washington Conference in fact, these questions have been exerting a marked and detrimental influence on Anglo-American relations, but to many people in this country, and probably in America also, their real nature was either obscure or misconceived. Henceforth, however, there should be no room for ignorance or misconception. We now know exactly how America interprets that over-worked word "parity." We know what she wants in the matter of naval strength, and we know, too, that her wants far outweigh her requirements. We have further become cognisant of the fact that her naval leaders hold very decided views on the subject of warship tonnage and armament. They have embraced the policy of "going the limit" in tons and guns, as befits a navy which, in theory, has an inexhaustible fund of wealth to draw upon. America has told us in plain terms that she aspires to absolute equality with the British Empire in battleships, cruisers, destroyers, and submarines, and we have raised not the slightest objection. It was only when she attempted to specify not only her own future standard of strength in cruisers, but that of the British Empire as well, that we demurred. Another useful purpose which the Geneva meeting served was to enable the British Empire for the first time to broadcast a comprehensive and detailed statement of its naval requirements. The world now knows precisely how we stand on this question, how far we are prepared to go in making sacrifices for the cause of peace, and, at the same time, what our irreducible minimum is in respect of naval defence. With this knowledge available there will be less encouragement for any other party, however well-intentioned, to invite us to court national destruction by crippling the defensive power of our Navy.

The British case at Geneva differed from the other two in that it conformed closely to the terms of the American President's invitation, besides embodying a far-reaching and practical programme of naval retrenchment which would, nevertheless, have left the existing balance of power undisturbed. While conceding the American claim to equality, it provided for a very substantial reduction in the cost of floating armament by imposing new restrictions on the displacement of every type of fighting vessel. Capital ships, cruising ships, torpedo craft, and submarines, all were to undergo a further reduction in tonnage, together with an extension of the age limit in each case, the effect of the latter being to postpone by several years the necessity of replacing older vessels. Under this arrangement a halt would have been called to the building of the large yet vulnerable cruisers of the 10,000-ton class, which are primarily units of aggression, and a dubious investment from both the tactical and economic points of view. It has never been disputed that adoption of the British plan would eventually have saved very large sums of money to all three nations concerned without endangering in the slightest degree their national security. But the plan, despite its manifold merits and its patent fairness to all parties, completely failed to impress the American delegates. Their own scheme, which bore every mark of hasty improvisation, was no more than a repetition of that which had been submitted at the Washington Conference in 1921, when the general naval position was vastly different from what it is to-day. It was a mere arithmetical formula, drawn up without the least regard for any save American convenience. It proposed a gross allotment of cruiser tonnage, 250,000 to 300,000 tons, which was palpably inadequate for British requirements, unless all future cruisers were to be of the smallest dimensions and lightest armament. Yet when it came to a question of determining the future standard, the American representatives refused to consider any reduction. They would be satisfied with nothing less than the existing unit of 10,000 tons, armed with 8in. guns. That meant that when, in course of time, we had to replace our present cruisers, we should have to be content with a total establishment of twenty-five to thirty ships, since we could not well afford to build ships inferior in fighting power to those of other navies. When the American proposal was analysed, its inadequacy became so obvious that the Washington Government agreed, albeit rather grudgingly, to raise the gross tonnage total to 400,000, a number still far below our minimum requirements, so long as the 10,000-ton cruiser remained the standard. In deference to the American desire for limitation by total tonnage, we did our utmost to persuade them to agree to a smaller type of ship. But all our efforts were in vain. They met every point by arguments which, we are bound to say, did more credit to their dialectical ingenuity than their technical knowledge. It is charitable to assume that their references to such elements of British naval supremacy as our "forty liners of high speed"—which only needed arming with 6in. guns to convert them *instanter* into fighting ships equal to any naval cruiser—and our chain of naval bases, were meant purely for domestic consumption, since this sort of propaganda was much too thin to impress experts. The truth is that the two halves of the American proposition were irreconcilable and mutually destructive. Limitation by total tonnage becomes practicable only when the common denominator, in this case the tonnage of the individual ship, has been established to the satisfaction of all parties. The American mistake lay in attempting to dictate the sum of tonnage without reference to the second integral factor. In these circumstances, agreement was hopeless from the first. The cause of the final collapse appears to have been American insistence on the retention of the 8in. gun for all cruisers, regardless of their tonnage. As we have said before, this point might have been conceded by our delegates, even though it would have meant the automatic relegation to a state of obsolescence of all but a small fraction of our present cruiser fleet. But the real cause of failure lies much deeper. It is to be sought in America's uncompromising adherence to an interpretation of the parity principle that would, in practice make her navy supreme in combatant power, because with her enviable freedom from dependence on seaborne trade, and therefore from the necessity of protecting commerce, she is at liberty to develop her fleet as a fighting entity pure and simple. In our case, on the other hand, con-

ditions are such that we must always put a considerable margin of our aggregate naval tonnage into cruising ships designed expressly for the protection of shipping, which must therefore be inferior in military value to cruisers built solely for fighting the most powerful members of their class. Unless this fundamental divergence, not merely of views, but of actual requirements, can be adjusted by concessions made in a spirit of true friendship and mutual trust, we do not see any advantage in renewing the negotiations which failed so signally at Geneva.

No one can safely predict the sequel to this abortive conference, but there are grounds for hoping that the natural sense of the two great English-speaking nations will preserve them from the utter folly of a shipbuilding race. There is much talk in America at the moment of a gigantic cruiser programme—ten ships a year for the next five years—but we take leave to doubt the willingness of the American people to have their substance squandered on armaments which are demonstrably unnecessary. We are equally confident that neither the British Government nor people would wish to "reply" to such an American programme unless its repercussions threatened to upset the equilibrium of naval power throughout the seven seas. That is the only real danger. When America, just after the war, suddenly decided that she must have the largest navy in the world, her challenge was promptly taken up by Japan, and the frenzied battleship rivalry of those two Powers during 1919–21 must inevitably have started a world-wide naval race had not America, in the nick of time, renounced her strange ambition and summoned the Washington Conference. We cannot believe that she now intends to revive the very policy that she abandoned six years ago, when its dangerous reactions had become too plain to be ignored.

Recent Express Locomotives.

The new locomotives now being placed on the London, Midland and Scottish Railway by Sir Henry Fowler, the first of which we illustrated in our issue of August 5th, have the distinction of being the most powerful ever employed on any of the several lines which go to form Britain's largest railway system; furthermore, the engines of the class to which they belong, together with Mr. C. B. Collett's new engines and Mr. Maunsell's Lord Nelson, probably mark the limit of size and power for the particular wheel arrangement employed—the ten-wheeled type. The six-coupled bogie locomotives has now been with us for some years and a number of very notable designs have been built. Not a few of our readers will recall the huge McIntosh ten-wheelers of 1903, at their time regarded by many as the last word in size and weight. Perhaps, however, from the point of view of development a more striking comparison is seen when we think of the Worsdell ten-wheeled express engines introduced on the old North-Eastern in 1899–1900. These particular locomotives were the first with that wheel arrangement ever constructed in this country for passenger service, and their weight, engine only, was, strange to say, just about equal to that borne on the coupled axles only of Sir Henry Fowler's engine as given by the estimated weights. In the matter of heating surfaces equally interesting figures are seen, for while the Worsdell engine had a total boiler heating surface of 1766 square feet, this is but equal to 93 per cent. of the tube surface only of the L.M.S. engine, the total heating surface of which is 2526 square feet, or more than 40 per cent. greater for an increase in engine weight of 35 per cent.

As indicating the development in general that has taken place, these simple computations are, from an historical standpoint, of interest; but what we are more desirous of now doing is to direct attention to the distinctive features of more recent designs, in particular the new Great Western, Southern, and London, Midland and Scottish locomotives. In these three classes we have those of most modern construction, embracing the ideas of locomotive engineers of experience and eminence. The locomotives in question have, moreover, been built to handle much the same train weights at very similar speeds. A glance at these different engines—we have illustrated each one in our pages—shows that in certain respects they are similar, but in others there is a marked difference. Looking at the boilers, and in particular considering the amount of heating surface provided, there seems little to choose between them. Actually the L.M.S. engine has the most, then comes the G.W., and afterwards the S.R. locomotive. In the order named this dimension is 2526, 2514, and 2365 square feet. Comparing weights with heating surfaces, the lightest engine is the L.M.S., with 75·4 lb. of engine weight per unit of heating surface, constituting, in our view, an excellent figure. The G.W. has 79·5 lb. and the S.R. 79 lb. Mr. Collett's engines have much the highest maximum tractive effort, the estimated value being 40,300 lb.; then comes the S.R. with 33,500 lb., and the L.M.S. with 33,150 lb. Comparative figures for the boiler demand factors—that is, the diameter of the driving wheels multiplied by the maximum tractive effort and divided by the total heating surface—show the lowest factor for the L.M.S. engine, the value being 1061 against 1120 and 1252 for the S.R. and G.W. locomotives. Evidently Sir Henry Fowler will, on the basis of equal speeds in revolutions per minute, realise with his engine a rather higher percentage of the maximum rated tractive effort than will the other locomotives; that is, of course, assuming equal evaporations per unit of heating surface, and we anticipate that the three boilers will prove closely equal in this respect. Whilst in boiler power and design all three engines are very similar, the same cannot be said of the engines. In the cylinder arrangement the differences are marked and most interesting. Sir Henry employs three cylinders for his locomotive, whilst the other two are of the four-cylinder type, but even then, very different, not only in the arrangement, but also in the matter of crank setting. Mr. Collett follows the design initiated by Mr. Churchward back in 1906, when the famous 4–4–2 No. 40 was turned out in the Swindon shops; but in view of the much higher axle loads adopted and indeed required to take care of the very high starting tractive effort, some modification in the distribution of the balance weights has, we understand, been made in order to reduce the "hammer blow," to use Webb's term. Mr. Maunsell, on the other hand, has set his cranks on the 135 deg. plan in order to obtain the benefits of an equal torque and paid very special attention to the balancing, and, as distinct from the G.W. engine, four separate sets of valve motion are used. The new L.M.S. engine with three cylinders and a divided drive has three valve gears, and although both Sir Henry's and Mr. Maunsell's designs have the advantage of an equalised torque, they have each higher adhesive factors than the G.W. engine, for which this figure is 3·74, as against 4·21 and 4·14 for the L.M.S. and S.R. locomotives. With so low a value we fancy the G.W. engines might slip at starting, so that unless conditions are favourable it would seem that the estimated tractive effort of 40,300 lb. will rarely be realised. In so far as the working steam pressures are concerned, the S.R. engine carries 220 lb. and the other two 250 lb., which represents a great advance. Here again there is a point of some interest, because the very numerous compounds put into service during the last few years by Sir Henry Fowler carry 200 lb., while his new simple expansion engines have the advantage of an extra 50 lb. It would be very interesting and probably instructive if one of the new ten-wheelers were built as a compound and its working results compared with the simples.

In looking over these three notable designs one is struck with the similarity which exists. Actually in power output there is little to choose, for the reason that, given equal cylinder efficiencies, power will be dependent upon evaporation, and, as already stated, all three boilers are in this respect much alike. As would be expected, the three-cylinder engine is lighter for a given amount of heating surface than either of the four-cylinder types, but of these, although Mr. Maunsell employs four sets of valve gear as against but two for the G.W. locomotive, his engine is rather the lighter of the two. We hope as time goes on to hear something as to the performance of these interesting examples of modern construction. Tests which show how the fuel burned compares with the power developed at the draw-bar would be valuable. All three locomotives are examples of good well-tried practice, but they in truth contain nothing which is new. It would be, therefore, a mistake to assert that any real move has been made to obtain by means of new ideas either in the shape of boiler design or valve motions superior results which could not be had by the common-sense application of well-proved machinery.

A floating dock which is to be built at Walsh Island, New South Wales, is to have a lifting capacity of 15,000 tons. It will be 630ft. long, 113ft. wide, and will take vessels of 29ft. draught.

The Engineering Industries of Canada.

No. I.

(By a Canadian Correspondent.)

Nowhere in the world is the value of engineering industries to civilisation more conspicuously displayed than in Canada. With their aid the scattered sections of this vast domain of 2,315,886 square miles of land, river and inland lake has been welded together by the building of 40,347 miles of steam railway, by canal systems which make inland navigation possible for sixteen hundred miles, by the boring of tunnels through mountains, and by the flinging of many bridges over chasms. The Dominion, larger than the United States and Alaska, with about 115,000,000 population, has to be administered and maintained by a population estimated at 9,400,000. Its problems of finance and commerce, of manufacturing and distribution, of foreign trade and internal trade, and of engineering are all bound up in this comparatively small population holding a vast expanse of territory. There cannot be too much pride that yesterday's wilderness is to-day's smiling farm land, because the people of Canada see always to-day's wilderness beyond which must be to-morrow's farms, and they see new mining areas of amazing riches against a murky background of partly explored or almost unknown territory in which there may be many other Porcupines, Kirkland Lakes, Cobalts and Rouyns, to mention only a few of the very rich or promising mining areas which have been opened up in the last decade and a-half.

The present position and future prospects of Canada's engineering industries cannot properly be understood unless the reader carries in his mind this picture of a gigantic task manfully undertaken and partly completed, and unless he keeps before him the idea that there will be and must be rapid increases of population, a continuous northward movement of agricultural, mining, industrial and forest activities, and a constant effort to replace imported manufactured goods by products of Canadian workshops and of Canadian labour. Tremendous changes will be worked by the expansion of agriculture alone. Of Canada's land area of 1,401,316,388 acres only 358,162,190 may be considered suitable for agriculture, and in 1921 there were occupied of this 140,887,903 acres, one-half of which has been improved, or only about 40 per cent. of what could be occupied. The problem varies as one goes westward from Prince Edward Island on the Atlantic Coast, where 97 per cent. of the available land is occupied, until in British Columbia on the Pacific Coast he finds that only 12·6 per cent. of the available land is in use. In the Prairie Provinces, because of the building of new Transcontinentals through virgin country, the area of possible farm lands taken up has advanced from 3 or 4 per cent. to nearly 50 per cent. in Saskatchewan, and more than 30 per cent. in Alberta. This extensive development has swelled the annual wheat production in Canada to more than four hundred million bushels, and the total agricultural revenue to more than three hundred and fifty thousand pounds sterling. Such rapid development has not only brought in its train engineering problems of magnitude in connection with transportation, transshipment and preservation, but it has been accompanied by a large growth in cities and in the activities of industrial areas. Farm implement manufacturers have tackled so successfully the problems of the farmer in every part of Canada that their products go not only to Canadian farms, but to farmers all over the world. The gigantic elevators at sea ports and at strategic points, such as Fort William and Port Arthur on the Great Lakes, are marvels of ingenuity for cleaning, drying, mixing, unloading and loading grain; and the countless elevators at country points all over the prairies do well the work for which they are intended. Large and wealthy milling companies have been built up along the route of the grain, and an ever increasing proportion leaves Canada ready for use by the baker. At the same time the extension of cities has brought grave problems to the engineer, who has had to provide water supply, drainage, sewage disposal, lighting, transportation, large hotels, office buildings and factories adequate to the changing conditions. Cities have been growing faster than was anticipated in the 'nineties, and so have continually been outgrowing provisions made for them in these respects. There is much more intelligent planning now than was once the case, and the tendency to-day is to construct from the first with an eye on future requirements so that they may be met by extension of facilities rather than by continual scrapping. In the past, in practically all these lines, it was the custom, whenever new problems arose which had not been solved by Canadian engineers, to seek advice from other lands. Sometimes help was obtained from the British Isles, but more often from the United States, where conditions were similar and talent more quickly available. Canadian engineers and engineering industries, however, have never looked helpless before any major problem, and they offer keen competition to any foreign firm seeking Canadian business.

The most spectacular engineering performances of recent years have not, however, had to do with cities.

The greatest part of the population is to be found in Ontario and Quebec, and there Canada's industrial life is centred. But these provinces have no coal or other fuel of consequence such as is to be found in the Western and Maritime Provinces. They are dowered, however, with innumerable rivers and lakes. Waterfalls and rapids abound, and there is therefore available a wealth of hydraulic power which is being harnessed in vast enterprises that are transforming the face of large tracts of country, changing the character of the pursuits of its inhabitants, and adding to the manufactured wealth of the Dominion. This power is being made available not alone for cities and for farms. A great deal of the water runs through those northern regions already referred to, which are rich in forests and minerals. Here waterfalls, once regarded as a disadvantage, are now one of Canada's chief assets. They make certain the development of large-scale industrial enterprises which otherwise would be impossible. As each great power undertaking has been completed new industries have sprung up in connection with it. Since the war so much power has been harnessed in Canada that every important industrial centre is fully supplied and has ample reserves for the future.

Naturally, in a country with a small population but great natural resources, the new industries springing up on the back of hydro-electric power and available transportation are those which seek products of world significance. The capitalists, both Canadian and American, who have been throwing their hundreds of millions of dollars into these enterprises, are after supplies of necessary raw material to meet a world demand. Thus, one has the amazing spectacle of the population of Canada increasing between 1921 and 1926 by only 7 per cent., while the installed water power capacity increased 65 per cent. In 1926 the installed water power capacity in the United States was about 97 H.P. per thousand of population, while in Canada it was 485 H.P. In other words, there is in Canada 4,556,000 W.H.P. for a population of 9,400,000, and it has been developed by a capital investment of £170,000,000.

Much of this power is supplying great pulp and paper mills, which are steadily grinding their way into the forest resources of the country. So much has been done in that way within a decade that it is doubtful whether this industry can with profit to the country grow much larger. More and more the public is becoming awake to the necessity of insuring that the utilisation of the trees shall not proceed at a greater rate than new growth. But a number of these mills have yet to realise their full possibilities, and they will be, for a long time to come, steady consumers of power.

As for mining, the expectation of life for the gold-fields of Ontario are yearly becoming more optimistic. The Rouyn area of Quebec possesses a wonderful mine in the Noranda, and many others are likely to be found. The question of continuance at depth has yet to be demonstrated. But new areas have come into view almost monthly within the last few years, and hydro-electric development is necessary at every stage of mining, as soon as prospecting has been completed.

It is safe to say that the demand for power will increase rather than decrease. With the population of Canada augmenting each decade by 20 per cent., and with these new areas being added constantly to producing territory, one can confidently look forward to a time when the present 4½ million horse-power will be insufficient. Fortunately, we have the authority of the Dominion Water Power Branch of the Department of the Interior for the statement that this amount represents only about 11 per cent. of the total power available. Three-quarters of the available power is to be found in Ontario, Quebec and Manitoba.

TABLE I.—*Available and Developed Water Power in Canada as on January 1st, 1927.*

Province.	Available 24-hour power at 80 per cent. efficiency.		Turbine installation H.P. developed
	At ordinary min. flow H.P.	At ordinary 6-months flow, H.P.	
British Columbia	1,931,142	5,103,460	460,562
Alberta	475,281	1,137,505	34,107
Saskatchewan	513,481	1,087,756	35
Manitoba	3,270,491	5,769,444	227,125
Ontario	4,950,300	6,808,190	1,790,588
Quebec	6,915,244	11,640,052	1,915,443
New Brunswick	50,406	120,807	47,231
Nova Scotia	20,751	128,264	65,702
Prince Edward Island	3,000	5,270	2,274
Yukon and North-West Territories	125,220	275,250	13,199
Canada	18,255,316	32,075,998	4,556,266

The capacity of the actual turbine installations is shown in Table I. together with the power obtainable from the minimum and ordinary flows of the rivers from which they derive their power.

The demand for current increases continually, not alone from companies and commissions operating telephone, telegraph, lighting and tramway systems, but from industries and from homes where it is continually displacing manual energy. At a very large number of homes in Ontario, for instance, electricity is used for washing clothes, for sweeping floors with vacuum sweepers, for cooking, for ironing, for toasting, and even to a limited extent for heating. The latter use may eventually be discouraged as the demand for power increases.

In that Province, large as is the development, as shown in Table I., there is not enough power available in the most thickly settled regions to supply the demand. The Hydro-Electric Power Commission of Ontario has been compelled to go to Quebec to get a supply of power to supplement that from its huge power plants at Niagara. This Commission, which draws its powers and its funds both from the Provincial Government and municipalities which co-operate, has numerous plants throughout Ontario developing in all about a million horse-power. Three of the plants are at Niagara Falls, the latest of these being the famous Queenston-Chippewa plant, with a capacity of 550,000 horse-power. The total investment of province and municipalities in the activities of this Commission aggregates more than £57,000,000, one-third of the Canadian investment, and it serves more than 400,000 customers in 500 urban and rural municipalities, including Toronto. It thus provides for the needs of a population of 2,220,000 people. It operates "at cost," and renders its bills to the municipalities, which, in turn, collect from the consumers. The average charge in these municipalities is under 2 cents per kilowatt-hour for four-fifths of the municipalities, and the average charge to consumers for power service is less than £5 a horse-power a year. Manitoba, Nova Scotia and New Brunswick also have Government power commissions. While Nova Scotia has extensive coal mines, water power developments have been worked in conjunction with steam plants quite successfully even adjacent to the mines.

The greatest development activity in the last three or four years has, however, taken place in the province of Quebec. Private corporations have done the work there instead of a Government Commission. The Shawinigan Water and Power Company, for instance, has five power stations with more than half a million horse-power installed capacity. One of these, 85 miles from Montreal (800,000 population), now generates 150,000 horse-power, and work is proceeding on plans which will bring the capacity up to 300,000. It serves 160 municipalities. Seventy miles east of Montreal is the St. Maurice River. At the upper end the Quebec Government recently completed one of the largest storage and regulating dams in the world. In a stretch of 13 miles on this river there are three hydro-electric power plants with a total capacity of about half-a-million horse-power.

Around Lake St. John and the Saguenay River, flowing from it, has grown in the last few years another power and industrial centre. More than half-a-million horse-power is being generated there, and this output will be more than doubled by 1930. Industries have sprung up to use the power, notably paper mills and electro-chemical works.

"I returned recently from a two-days' visit to this locality," said Brigadier-General C. H. Mitchell, C.B., C.M.G., C.E., President of the Toronto Board of Trade, "and found that in the eighteen months since my previous visit the generated power had been increased by 250,000 horse-power, construction on a fourth power project of even greater magnitude had been commenced, and an aluminium company had built and put into production a manufacturing plant shortly to be the second largest of its kind."

"This region," he continued, "offers a striking example of the industrial possibilities of the conjunction of cheap power, raw materials and transportation facilities. Paper companies get their wood supply not only from their adjacent forests, but from those up the rivers of the north and by water transport *viâ* the Saguenay River from the Island of Anticosti in the Gulf of St. Lawrence. The aluminium company gets its raw materials of petroleum coke from Texas, and alumina, bauxite from British Guiana by water *viâ* the St. Lawrence and Saguenay rivers with draughts sufficient for the largest ocean vessels."

Quebec tributaries of the Ottawa River are now being harnessed. The Gatineau River alone will produce 300,000 horse-power, and as much more is planned for a nearby river, which will supply the Ontario Hydro-Electric Power Commission with an additional supply. As the Ottawa River itself has great power possibilities, Government regulation works have been installed in its upper reaches.

From the St. Lawrence River only 250,000 horse-power is being produced, but its power possibilities are enormous. Only the political and financial difficulties have prevented its exploitation before this. In Ontario, where half the available power is, this river is the international boundary between Canada and the United States. The lower portion of the power area is 60 miles long and is wholly in the province of Quebec. These two reaches of the river will permit an eventual installed capacity of three and a-half million horse-power. An international commission has reported in favour of a development which will canalise the river so that ocean vessels can get up into the Great Lakes and also make use of the power. The navigation plans have awakened hostility from sections which fear it will divert traffic from them, but the growing power needs on both sides of the international boundary are likely to hasten a decision much sooner than would have been thought possible five years ago. Once the slow mills of Government negotiation and legislation have been concluded, all Canadian industrial life will be accelerated by the demands made in connection with the great expenditures inherent in these plans, and one can only imagine the nature and size of the industrial life which will cluster around the St. Lawrence and the Ottawa rivers when these enormous floods of energy are made available for the uses of man. Many predict that one result will be the electrification of all steam railroads in Ontario, and possibly in Quebec, thus reducing by a large amount with that single item the dependence of these roads for their supplies on American sources. Electric locomotives are already in limited use. As these developments represent the most amazing in Canada's recent history, the following table, compiled from reports of the Dominion Water Power Branch, will be interesting, as giving a bird's eye view of the present situation all over Canada.

The first column of figures shows the power developed for sale by hydro-electric stations, and the next two columns the additional power developed by various industries for their own purposes in addition to what they get from the stations.

TABLE II.—*Developed Water Power in Canada as at January 1st, 1927.*

	Turbine installation in horse-power.				Population.	Total installation per 1000 population, H.P.
	In central electric stations.	In pulp and paper mills.	In other industries.	Total.	1926.	
British Columbia	318,179	80,500	61,883	460,562	568,400	810
Alberta	33,520	—	587	34,107	607,000	56
Saskatchewan	—	—	35	35	823,000	0·04
Manitoba	210,725	—	16,400	227,125	638 000	356
Ontario	1,508,266	174,548	107,774	1,790,588	3,145,000	569
Quebec	1,546,692	242,044	126,707	1,915,000	2,561,800	748
New Brunswick	25,325	13,003	8,403	47,231	407,200	116
Nova Scotia	31,942	16,636	17,124	65,702	540,000	122
Prince Edward Island	279	—	1,995	2,274	87,000	26
Yukon and N.W.T.	10,000	—	3,199	13,199	12,300	1,073
Canada	3,635,428	526,731	344,107	4,556,266	9,390,300	485

It may be added that the statistics given do not take into account the power which may yet be developed from many rapids and falls of greater or lesser power capacity scattered on rivers and streams from coast to coast, and which have not yet been recorded. Nor has any thought been given to the power concentrations possible on rivers of gradual gradient. The investment in central electric power stations alone is £145,200,000, and they employ more than 14,000 people, paying in salaries and wages nearly four million pounds per year.

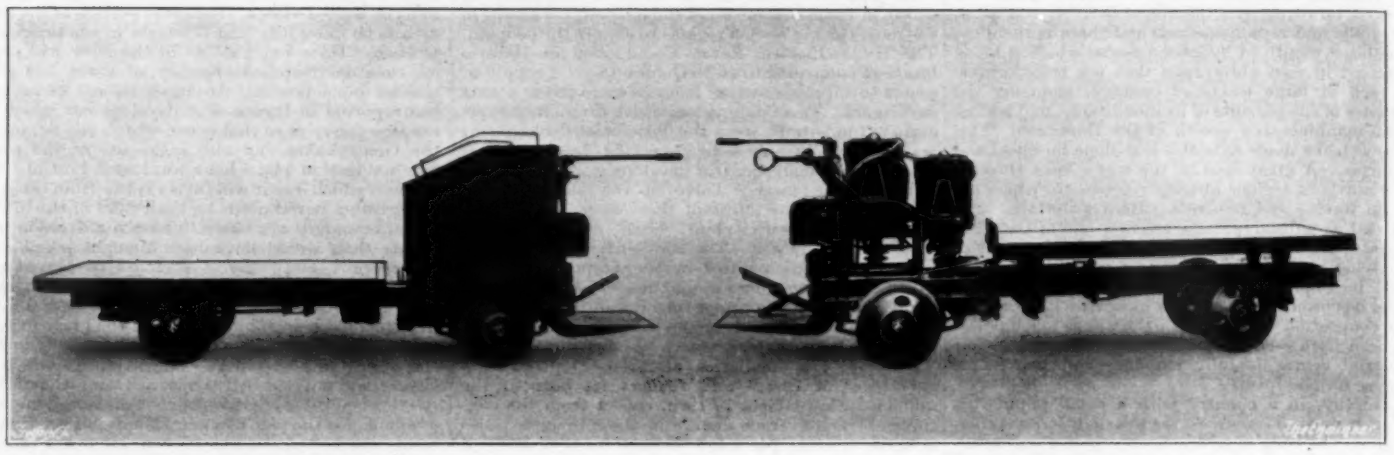
The rapid expansion of development enterprises in the Dominion is evidenced by the external trade figures for the first six months of 1927. They exceed £221,000,000, an increase of £11,000,000 over the first six months of 1925. In that year, however, there was a favourable balance of £16,000,000 and in 1926, for the same six months, of £15,000,000, while to the end of June in 1927 this balance had fallen to £7,000,000, as, it is believed, a direct result of the high rate at which new construction is proceeding, the opening up of new mining fields, the extensive hydro-electric developments already referred to and other outstanding activities which require increasing importations of steel, machinery and other products which will add quickly to the productive capacity of the country. The increase in this trade is much greater than the figures show, because of the lower level of commodity prices.

(To be continued.)

APPLICATIONS are being invited by the Institution of Civil Engineers until September 16th for the Yarrow and William Lindley scholarships. Applicants for the Yarrow scholarships must be British subjects who are not more than twenty-three years of age and who, desiring to become engineers, lack sufficient means to enable them to pursue their practical training or their scientific education. The scholarships are ordinarily of values from £50–£100 per annum for one, two or three years. Applicants for the William Lindley scholarships must not be more than twenty-three years of age, and must be children of corporate members of the Institution, whose means are inadequate to defray all the expenses incidental to an engineering training. The fund provides for (*a*) a major scholarship of £80 per annum for engineering study at the University of Cambridge, tenable for three years, and (*b*) a scholarship of £40 per annum for scientific education or practical training in engineering.

TWO-TON ELEVATING PLATFORM TRUCK

ELECTRICARS, LTD., BIRMINGHAM, ENGINEERS



FIGS. 1 AND 2

A New Elevating Platform Truck.

A NEW 2-ton electric elevating platform truck, designed on somewhat unusual lines, has been put upon the market by Electricars, Ltd., of Landor-street, Birmingham. The object of this type of truck is, of course, to save the time that an ordinary truck remains stationary whilst the load is put upon its platform. This loss of time is avoided by placing the load on a separate stillage or low platform; under which the truck platform is driven and afterwards raised by an electric motor, a few inches from the ground. The truck then carries the load to its destination, and in the meantime another stillage can be loaded in readiness for the truck's return.

In the design of this new vehicle, introduced by Electricars, Ltd., every endeavour has been made to make its operation simple, so that unskilled people can operate it; and attention has also been paid to the important question of making those parts that require periodical attention accessible.

The complete vehicle is shown in Fig. 1, whilst Figs. 2 and 3 show the truck with the battery removed. To facilitate the removal of the battery, it is placed in a self-contained housing with holes for a sling, and the centre part of this housing accommodates the motors, the cells being arranged along each side. When the battery housing and platform have been removed the whole of the mechanism is exposed, and, as will be gathered from the illustrations, all the main driving mechanism is arranged over the driving axle, where the battery is also placed. There are, of course, two motors, one for propulsion and the other for elevating the platform. Both these motors are mounted vertically—as shown in Figs. 2 and 3—and in the drawing of the general arrangement—Fig. 4—where it will be seen that at the front of the vehicle there are the usual foot-plate, control gear and steering levers.

The truck is built in four types designated TLA, TLB, TLC and TLD, the first two models having low and high platforms respectively, and four-wheel steering gear, whilst both the other models have two-wheel steering gear; the LTD model being a low platform truck, and the LTD model a high platform truck. In all cases, however, the platforms may be constructed in various sizes to meet purchasers' requirements. All the main members are composed of rolled mild steel channel rigidly cleated and bolted, and the side members extend along the full length of the truck. A substantial framing supports the motors and batteries in the manner shown. At the front end the truck is mounted on the driving axle by underslung semi-elliptic springs with bronze bushes and hardened ground pins fitted with lubricators.

In the case of trucks fitted with four-wheel steering gear, the cast steel axle casing below the driving motor—see Fig. 5—contains a hardened steel worm and phosphor bronze wheel with a differential all mounted on ball bearings, whilst at the end of the stub axles the road wheels are driven by a three-wheel bevel gear drive, with the centre wheel mounted on a swivel pin so that the wheels may be driven on a steering lock. All the shafts and gears are composed of nickel steel and the casings enclosing the gears are filled with oil. The trailing axle arrangement—see Fig. 6—is composed of cast steel bed and stub axles, and hardened and ground swivel pins are provided for steering purposes. The cast steel disc type wheels are mounted on ball bearings with dust covers and solid band rubber trolley tires are fitted to all the wheels. The motors for propelling the truck and that for elevating the platform are mounted vertically side by side in the centre of the driving axle. They are both totally enclosed four-pole series-wound machines, and they are capable of developing high overloads without undue temperature rise. The armatures run in ball bearings, and bearings of this type also take the armature weight. The motor that serves for elevating the platform is mounted directly over the elevating gear-box.

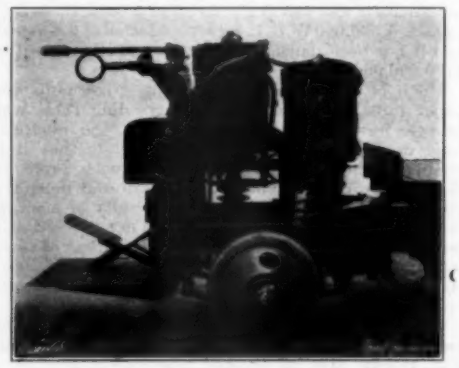


FIG. 3—FRONT END OF TRUCK

Between the propelling motor and the axle worm shaft there are spiders and fabric joints—one on the armature shaft and the other on the axle worm shaft, and there is a sliding square propeller shaft between the joints, the propeller shaft being enclosed by a leather retaining sleeve—as shown in the drawing Fig. 4. Similarly, there are fabric joints and spiders between the armature shaft and the gear-box drive shaft of the elevating transmission gear. Calliper-type "Ferodo" lined shoes act on the brake drum on the armature shaft of the motors, and the shoes are pivoted at one end and spring loaded at the other. When the truck

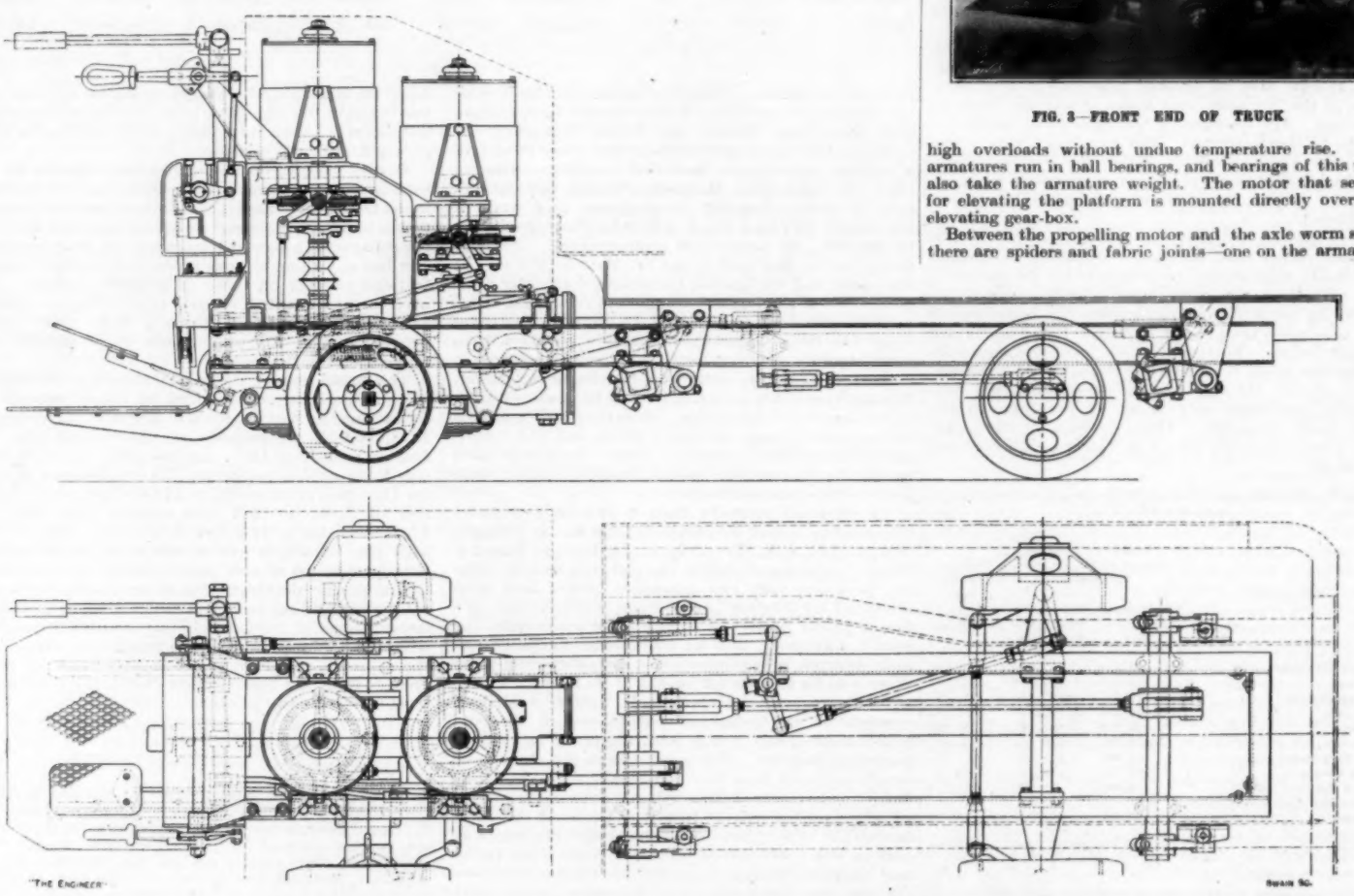


FIG. 4—ELEVATION AND PLAN OF ELEVATING PLATFORM TRUCK

is standing the brakes are in the "on" position, but when the main switch is operated for starting the truck the brakes are moved to the "off" position by means of a cam, and they are automatically applied again when the main circuit is broken. The depression of the foot pedal closes the main driving switch and releases the brakes, whilst on releasing the pressure of the pedal the circuit is broken and the brakes are applied.

The elevating motor main switch is similarly interlocked. When pressure is applied to the starting pedal for this motor the platform is set in motion and the motor is stopped automatically at the end of the elevating and lowering operations. Centre-point tiller steering is applied to all four wheels, and all shafts and rods associated with the steering system are composed of mild steel, whilst the levers of the steering arms are steel castings, bushed and working on hardened and ground pins or ball pins with lubricators.

The battery housing has a steel angle framing and sheet steel covering lined with wood treated with insulating material, and a sheet steel lid is provided to enable the cells to be inspected and to be maintained in proper working order. The drum type controller, which gives three speeds in both directions, has heavy fingers and removable contacts which are mounted with a view to accessibility. The main switch, which is also of the drum type, is mounted on the main spindle of the speed controller. It is provided with the same type of fingers as the controller, and, as already indicated, it is connected to a foot pedal. A quick-brake index device is fitted to the speed controller and main switch drums. In the elevating gear-box, which is filled with oil, there are double reduction gears, the first working on ball bearings and the final gear on bronze bushes, the crank for operating the platform being mounted on the second reduction worm wheel shaft. At each corner of the loading platform there is a lever, and as shown in the drawing—Fig. 4—there are also levers at the other ends of two transverse shafts with bearings under the frame side members. The shafts are centrally connected by a pull bar and inclined levers, and are rotated by the lever and link connection to the gear-box. When the platform is in the "down" position the platform levers are in the horizontal position, and their rotation elevates the platform until the levers are in the vertical position. All the levers are steel castings, and the shafts are composed of mild steel mounted in bronze bushed bearings. The elevating switch is of the knife type, and is connected to the elevating handle and brake.

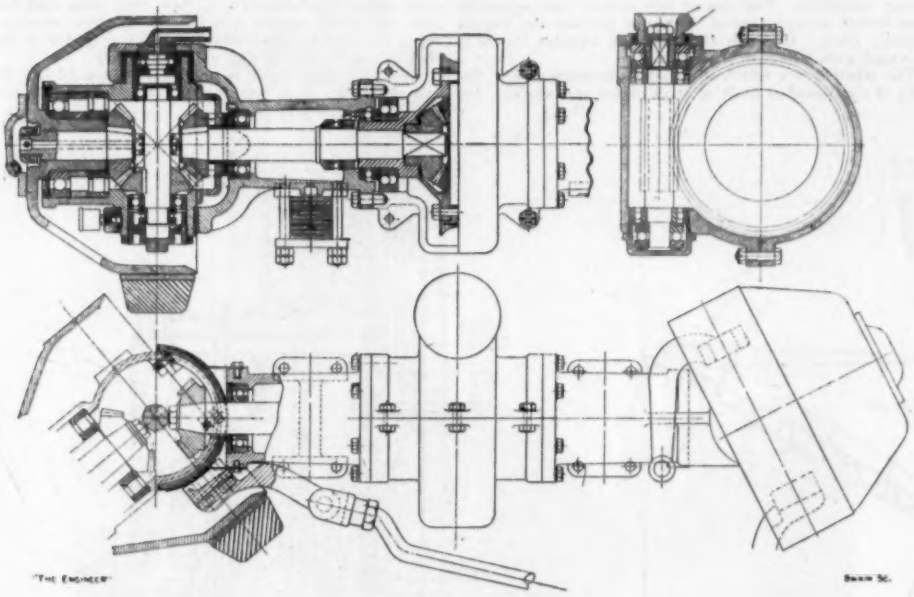


FIG. 5—FRONT AXLE ARRANGEMENT

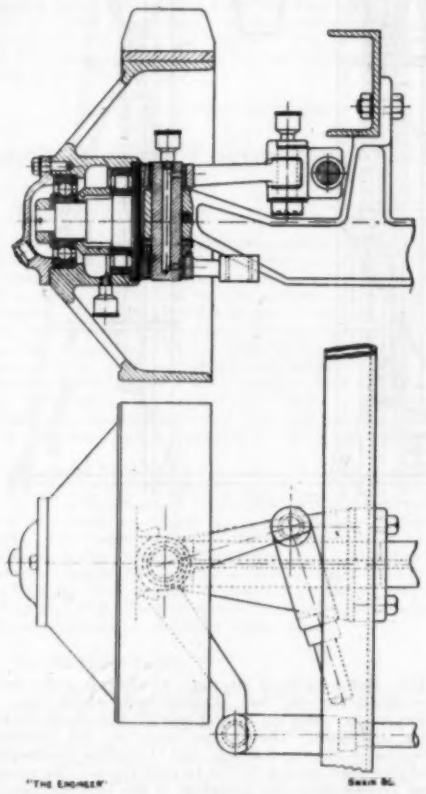


FIG. 6—TRAILING AXLE ARRANGEMENT

Electrode Steam Generators.

For raising steam by means of electricity, electrode steam generators may be connected directly to a high-tension supply, and in the case of three-phase pressures of 3000 to 8000 volts electrode boilers can be designed for capacities of 300 kW upwards, while at higher pressures it is possible to build these steam generators in sizes up to 5000 kW and over. Electrode steam generators are particularly suitable for utilising electrical energy that is supplied by electricity undertakings at low rates during periods of low load. The illustration Fig. 1 shows an electrical steam raising equipment built by the Oerlikon Company and installed by the electricity works of Aarau, Switzerland, at the Lonstroff rubber works in that town, the capacity of the plant being 600 kW. The steam produced in the electrode boiler during the day is led either directly to the presses and cookers or into the old flue boilers which now serve as a standby, but, as a matter of fact, since the installation of the electrode boiler in 1920 the old boilers have not been fired.

In conjunction with Escher, Wyss and Co., of Zürich, the Oerlikon Company has installed a considerable number of these boilers in various parts of the world, and they are said to have given complete satisfaction. In a hospital in the city of Basle a 1200 kW boiler—see Fig. 2—designed for a pressure of 6000 volts, has been in operation, and a steam accumulator with a capacity equivalent to 2500 kW hours feeds the different parts of the hospital when the electrode boiler is not in use. This steam accumulator works up to a pressure of 170 lb. per square inch, and it supplies the steam through a reducing valve at any desired pressure below that value. Steam is used for the kitchen and laundry. Hot water is also needed, and it is provided by a separate counter-flow apparatus supplied with steam generated in the electrode boiler, the hot water being stored in large tanks. Two similar electrode boilers have recently been ordered from the Oerlikon Company for use in this country, and in this case the current is to be obtained from a steam power station at reduced rates during the night.

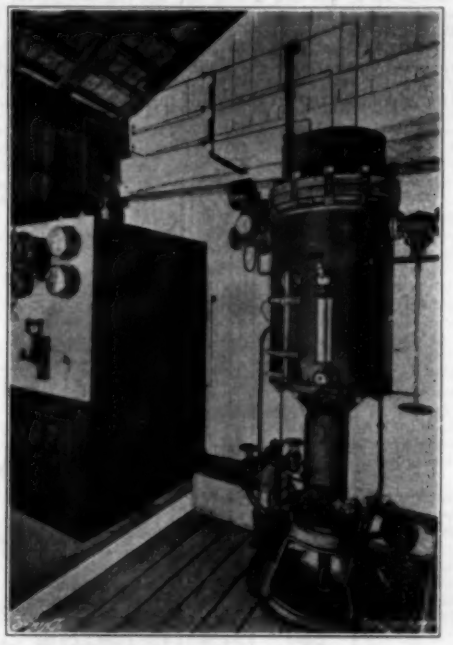


FIG. 1—600 KW. ELECTRODE BOILER

As no coal storage room or chimneys are needed, and smoke is entirely eliminated, the electric boiler has in some cases much to recommend it. The output can easily be regulated by varying the level of the water and the maximum output corresponds to the level at which the surface of the electrodes in contact with the water is greatest. As the boiler has no storage capacity it can be put into operation very rapidly. In outward appearance the low-tension electrode boiler resembles the high-tension boiler, but there are naturally certain differences in the construction. The electrodes are separated by insulators of simple design mounted on an iron frame inside the boiler. The bushings of the electrodes in the cover of the high-tension boiler are somewhat longer than those in the low-tension boiler, but consist in both cases of three simple sleeves. There are no stuffing-boxes, for the joints are made tight as the result of the pressure inside the boiler. The wear on the electrodes is said to be very small.

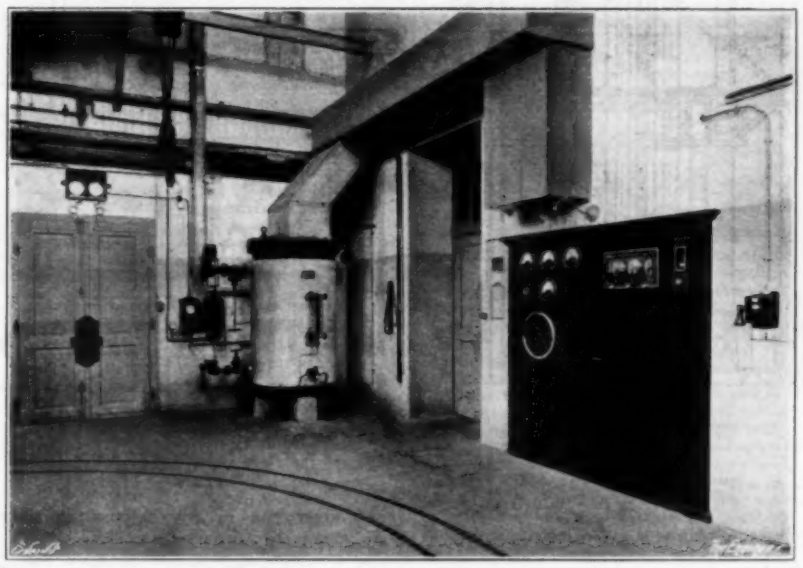


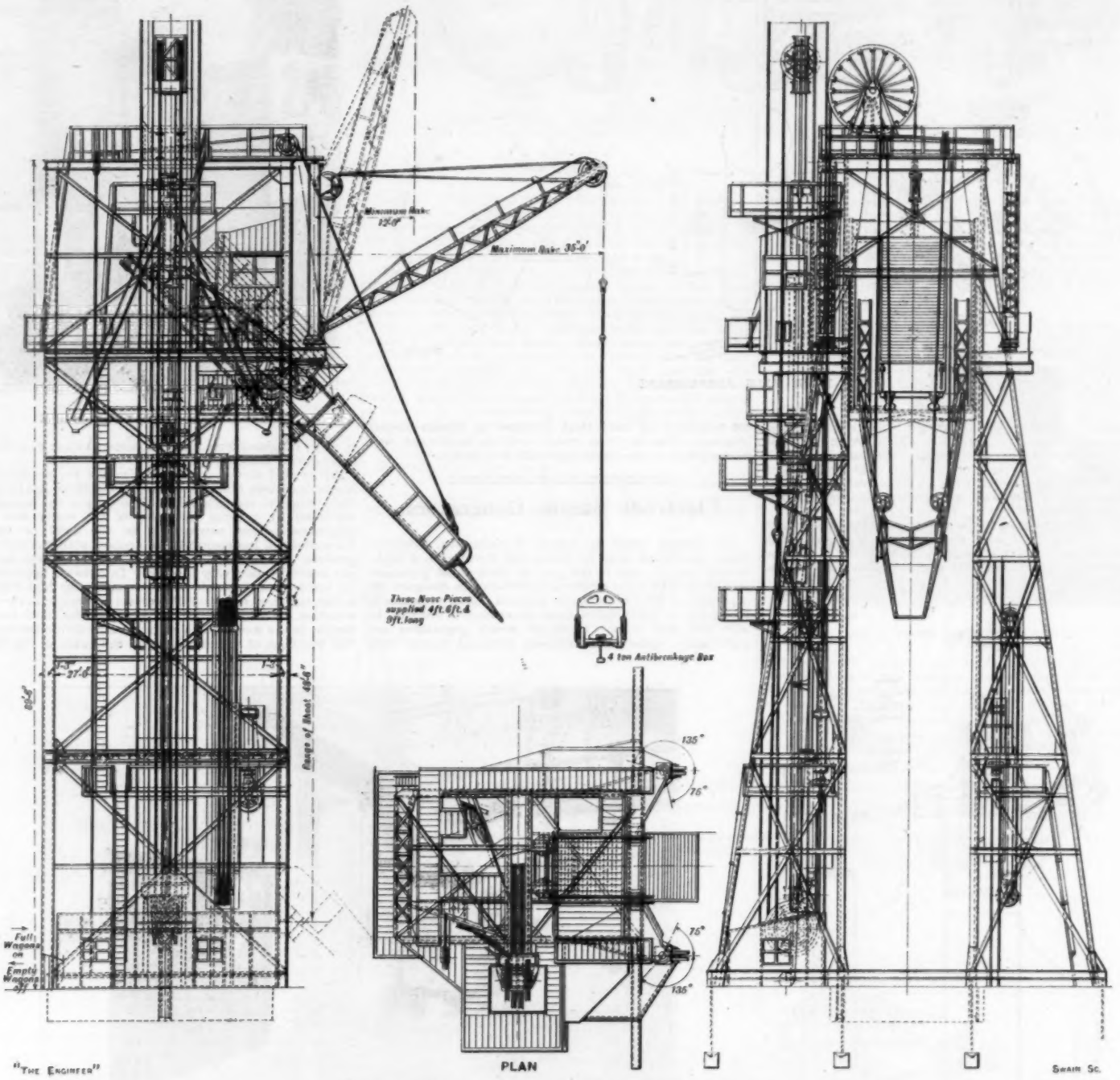
FIG. 2—1200 KW. ELECTRODE BOILER

The electrodes are secured to the boiler cover and they can therefore easily be removed by raising the cover. Tests on a 1200-kW boiler designed for a pressure of 6400 volts have shown that the efficiency is 98 per cent. For protecting the plant a triple-pole oil circuit breaker is mounted on the control panel and is fitted with three overload relays, and as an additional safeguard two contacts are fitted to the boiler, one of which switches off the feed pump if the water in the boiler reaches too high a level, whilst the other contact, which is placed at a lower level, causes the main circuit breaker to open when the level of the water drops too low and thus prevents interruption of the current between the electrodes.

New Coal Hoists in South Wales.

Five 30-ton hydraulically-operated fixed coal hoists have recently been supplied to the Great Western Railway and erected in the South Wales area by the engine works department of Sir W. G. Armstrong, Whitworth and Co., Ltd. Two of the hoists have been installed at the Port Talbot docks, two at the Barry docks and one at the Newport docks. There are slight minor variations in the dimensions of the five hoists, but our engravings representing one of the Port Talbot hoists, may be taken as illustrative of the common general design.

The hoist illustrated is capable of lifting a 20-ton coal wagon—representing a gross lift of 30 tons—to a height of 60ft. above the quay level at a speed of 180ft. per minute. At any point of the lift the cradle carrying the wagon can be stopped and the wagon tipped to discharge its contents through end doors down an adjustable shoot into the hold of a vessel lying at the quay.



COAL HOIST FOR 20-TON WAGONS AT PORT TALBOT

The framing of the hoist is built up of rolled steel channels, angles and plates riveted together. The front framing consists of two vertical and two raking struts, and the back of two vertical struts braced together and held down by means of four bolts provided with cast iron washers. The sides consist of a central strut braced to the front and back frames and carrying horizontal girders for the support of the hydraulic cylinders, which operate the hoist and its attached cranes. At the top, the structure is capped with a frame arranged to carry the sheaves for the cradle lifting and tipping ropes, the sheaves for the nose end of the shoot and the top sockets for the cranes. Down the full height of the structure on one side there extends a casing containing the hydraulic cylinders and rams, and their associated gear for the lifting and tipping motions. A shorter casing on the same side and a corresponding casing on the other side enclose the hydraulic ram equipment for the two cranes.

The lifting cradle consists of a base with sides tied together at the top by a girder to which the lifting ropes are attached through a spring connection designed to take up shocks. The cradle is guided by means of eight rollers working against the central vertical members of the side framing. On each side of the cradle a wooden platform is provided for the accommodation of the tippers. The tipping frame forming part of the cradle is equipped with bridge rails set at the standard gauge and bent upwards at the seaward end, to form stops for the leading wheels of the wagon. The frame is pivoted to the front girder of the cradle by means of steel pins and steel brackets, and at the rear end is attached to the tipping ropes through spring couplings. Tail chains and sliding bars operated from levers at each side of the frame prevent the wagon running back. Between the rails the tipping frame is provided with a floor of steel plates.

The shoot down which the coal is discharged into the hold of the vessel is built of steel plates and angles. Its working angle is 45 deg., but it can be raised vertically against the side of the structure in a position clear of the vessel berthed alongside the hoist. Three extension pieces are provided whereby the shoot can be lengthened by 4ft., 6ft. or 9ft. Wing doors in the shoot regulate the flow of the coal, but no screening arrangements were required under the contract. The nose end of the shoot is supported by a steel wire rope having a 4 to 1 purchase. This rope is led over sheaves on the top framing of the structure, and then down the side to a barrel at the quay level, which is driven through gearing by a horizontal hydraulic engine. The movement of the butt end of the shoot is effected by moving the cradle. For this purpose the girder carrying the butt end is provided with cast steel guide brackets, carrying pawls which engage with cast iron racks bolted to the vertical struts of the front frame. Safety guard chains extending from the upper part of the framing are attached to the butt end of the shoot in such a way as to prevent the shoot falling in the event of its becoming displaced by accident.

The hydraulic machinery is designed to utilise a working pressure of 700 lb. per square inch. The lifting of the cradle is effected by means of two cylinders, one of 20in. and the other of 8½in. diameter, both having a working stroke of 30ft. 6in. The rams of both these cylinders work downwards, and at their lower ends are coupled to a common crosshead carrying four sheaves. The actual lifting force is exerted by the larger cylinder; the smaller is a constant pressure cylinder, and exerts a balancing force only. The lifting ropes passing round two of the sheaves on the crosshead are made fast to the framing through springs, which take up shocks and through an equalising device designed to make each rope take its share of the load. At the top of the hoist the ropes pass over sheaves constructed of cast iron rims and bosses with mild steel spokes cast in. From these sheaves the ropes descend to the cradle, to the top girder of which they are anchored through shock absorbers.

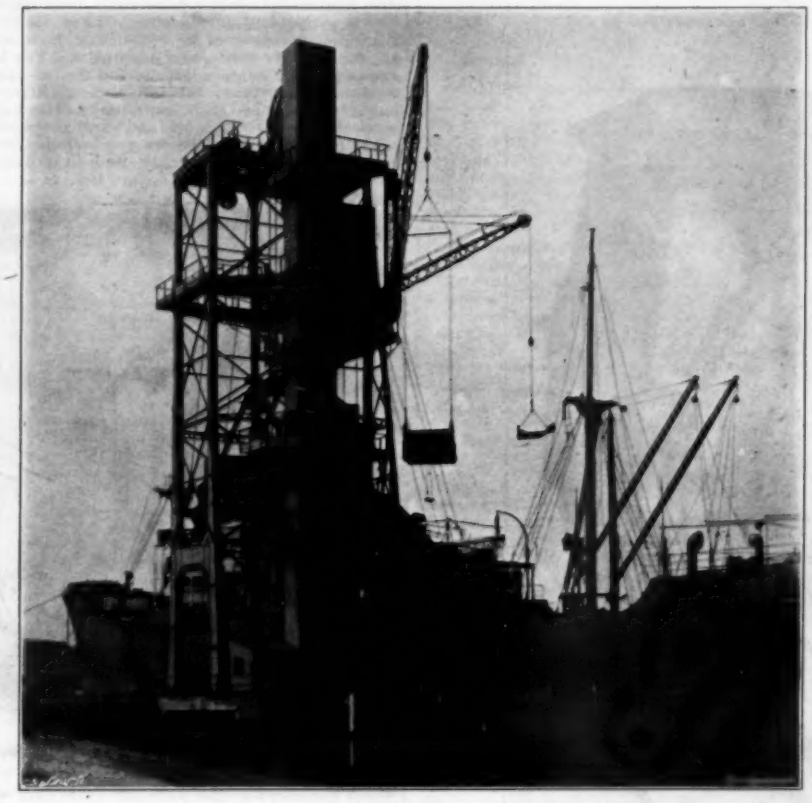
The tipping cylinder is mounted on top of the lifting cylinders. Its ram, working upwards, has a diameter of 14½in. and a stroke of 9ft. 6in. At the top of the ram is a crosshead carrying two sheaves from which ropes pass downwards round the second pair of sheaves on the lifting ram crosshead. Thence the ropes are led upwards to sheaves on the top framing, and thereafter downwards to the two rear corners of the tipping frame. By means of this arrangement the operation of the hoisting ram pulls in or pays out the hoisting and tipping ropes at the same rate, with the result that the cradle can be raised or lowered without disturbing the tipping frame. At the same time the tipping cylinder is available to operate the tipping frame at any height of the cradle.

Cut-off gear is provided to come into operation at the top and bottom of the lifting range. All the valves are operated by means of chains leading from them to the operating cabin. Indicator plates are fitted in the cabin to show the position reached by the cradle and the amount it has still to travel to reach any given height.

Of the two cranes with which the hoist is equipped, one is of 6 tons capacity and is employed to support a 4-ton "anti-breakage" box. The other crane is of 3 tons capacity and is intended for general use, such as for lift-

COAL HOIST FOR 20-TON WAGONS

SIR W. G. ARMSTRONG, WHITWORTH AND CO., LTD., LONDON, ENGINEERS



ing deck beams, shoot extension pieces, and so forth. The larger crane can work over a total range of about 80ft., so as to permit the anti-breakage box to be suspended anywhere from the point of the shoot when in its highest position down to the bottom of the ship's hold. Each crane has a maximum radius of 35ft. and can be derricked back to a radius of 12ft. The cranes are operated by hydraulic cylinders attached to the side frames, the power supplied being sufficient to hoist the load on either at a speed of 180ft. per minute. At the maximum radius the slewing speed is 200ft. per minute. The lifting, slewing and derricking operations can be performed either separately or simultaneously.

South African Engineering Notes.

Union Steel Corporation.

THE building of the fourth melting furnace at the Vereeniging steel works of the Union Steel Corporation (of South Africa) was completed a month or two back, and with that additional furnace capacity the works will be capable of producing 50,000 tons of steel per annum. The construction of the wire works at Vereeniging has also been completed, the rod mill has commenced operations, and the plant is running very satisfactorily. The Newcastle blast-furnace of the company, which was brought into commission on June 18th last year, has been continuously producing pig iron of the highest quality, and is more than meeting the present demands of the country.

Fluorspar Discovery.

An important discovery of fluorspar is reported to have been made on a farm about 6 miles from Naboomspruit. The quarry is 3 miles from the main road, and a truckload a day is being despatched from Naboomspruit Station. Nearly 130 tons have already been despatched to America. The quantity available is very great, and it is anticipated that there should be a large export trade as soon as transport facilities are improved.

The Torbanite Fields.

Interest in the torbanite deposits in the Ermelo district of the Transvaal has recently been revived. Two of the leading companies concerned are known to have despatched large quantities of crude torbanite for experimental purposes, the one company to England and the other to the Continent, and further developments are expected shortly. It is rumoured that, should the result of these experiments prove favourable the necessary capital will be available, in which case the deposit would be worked on an extensive scale. In view of the beneficial effect such operations would have on the district generally, keen interest is taken in the matter.

New Engineering Works.

From information to hand it would appear that the new firm registered some little time ago at Pretoria under the style of Beyer, Peacock and Co. (S.A.) Proprietary, Ltd., intends to erect works at Bloemfontein. Mr. J. W. Schlesinger, one of the Union's foremost business men, who has large and varied interests in different parts of the country, is stated to have concluded an agreement for the purchase of a farm at Bloemfontein on behalf of a certain big engineering firm in England, which already has representatives in this country and commands very large financial resources. It is freely stated that Messrs. Beyer, Peacock are the British firm concerned and that the venture will be started with a capital of over two millions. The farm in question is named Bloemspruit, and is situated right up against the railway workshops at Bloemfontein with an extent of about 1000 morgen (about 2200 acres). The intention, it is believed, is to utilise this farm for the establishment of an engineering industry which will manufacture, with steel from the Pretoria works, railway materials from locomotives to rails, and even, it is said, guns, telephone requirements and motor cars. The central position of Bloemfontein, and the facilities it offers as regards site and proximity to large railway workshops, are urged as the reasons for the site for the new enterprise being selected there, but these must be much greater than are apparent to outweigh the claims of Pretoria, if the State-controlled steel industry is established there, as seems to be the intention. With the steel works in operation at Pretoria the proposed engineering industry would be supplied with steel with practically no railage, while the coal pits of Witbank are close at hand. There is also abundance of electrical power to be had at a fraction of a penny per unit, and the municipality has professed itself ready to supply ample water at very low rates. There is, therefore, much curiosity over this question of the site, and some are inclined to think that if Bloemfontein has been selected there must be some inducement over and above any natural advantages which that town possesses.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

BRITISH CONDENSERS.

SIR,—I have read with considerable interest the leading article entitled "Tube Arrangements of Condensers" in your issue of July 15th, 1927, and more especially the reference to condensing plant design, and because of the world-wide circulation of your paper it seems to me necessary that a statement from a British manufacturer should be forthcoming.

You suggest that a committee should be appointed to report on the actual performance of various designs of British condensers, such as has been done recently in the case of the marine oil engine, and whilst in general such a step should be welcomed, I am thoroughly satisfied that the British product is so well ahead of the foreign article that there need be no apprehension regarding the future. The evolution which has taken place in condenser design within the last three or four years can only be described as speeding forward in character, and it is significant to note that the firms which have been the early pioneers in the condensing plant business have led the way in these latest developments. The development of the condenser has resulted in a unit being produced with a very much higher efficiency than anything hitherto constructed, and it has been evolved by a general appreciation of the fact that there were certain undesirable features in the then existing condenser design which could readily be eliminated.

The new design of condenser, which is commonly referred to as the "regenerative type," has, as the basis of its design, the elimination of pressure drop on the steam side, the reduction of the condensate temperature depreciation to zero, and of the oxygen contents of the condensate to so low a point that it is suitable, without further treatment, for boiler feed purposes.

It is recognised that in any surface condenser the tube arrangement is the most important point in the design. In producing the regenerative condenser this feature has been submitted to the closest scientific research, with the result that the tube distribution differs very radically from what had previously been accepted as almost finality in this part of the design. It is to this radical departure from previous practice that the results mentioned in the foregoing are chiefly due, and in addition the heat transmission is much higher than has ever been obtained before.

It is interesting to note that the value of this type of condenser is now being appreciated and adopted in various countries abroad.

These developments have resulted in a number of patents which are not available to those who have not been associated in the production of the new type of condenser. It is quite possible, therefore, that they have found it difficult to compete with the latest practice, and on this account have found it necessary either to negotiate a licence with manufacturers of the regenerative type of condenser or to adopt what continental manufacturers are able to offer them.

As you indicate, certain manufacturers chose the latter course, and, as you point out, this in itself, while of little significance, is harmful to British prestige and is an admission of inventive bankruptcy. However, it can be emphatically stated that by no stretch of imagination can it be said that "the best British manufacturers were working under foreign licences." Regarding the developments which have taken place with regenerative feed heating plants, British manufacturers have nothing to learn from American or continental manufacturers.

One of the troubles is that, owing to the somewhat conservative attitude adopted in this country, we have comparatively little in this country to show our overseas friends in the way of regenerative feed-heating plants; it is, however, encouraging to record that in some of the latest plant equipments the thermal advantages of multi-stage feed heating is being fully appreciated by the engineers.

It may also be pointed out that the evolution on the feed water cycle which has taken place from time to time and which finally evolved what is known as the "closed circuit feed water system" is entirely a British development.

It may be of interest to state that my firm is in continual competition abroad with continental and American manufacturers and is still able to obtain a full share of what is going. This situation can only be achieved by the employment, which is common in every branch of the engineering industry, of the most thoroughly trained and enthusiastic technical staff and continuous experimenting, and this is specially important in condensing plant work, which embraces such a large number of individual items in the complete plant, all of which are open to continual improvement.

I have no hesitation in saying, therefore, that all is well in the condensing plant business in this country, that the British designs are the best, and that the lead in design which the founders of the industry passed on to us is not being thrown away by us, either through lack of enterprise or initiative, and that this lead will be continued providing the same measures adopted by certain companies continue in the future.

In conclusion, I should like to add my support to the views so often expressed, that for a revival of trade throughout the world it is necessary to remove the serious artificial impediments that for years have been acting adversely to our interests in this direction. It is recognised in this country that the actual productive resources of the world have been more than adequate, but limitations placed on their distribution have caused depression and scarcity where activity of demand and general prosperity should prevail, as effective liberty in international trading is one of the most important remedies for the present inactivity in commerce.

We need not doubt that the old country is still running true to its natural form and that in the end we shall see the restoration and maintenance of healthy conditions.

HAROLD G. ALLEN.

W. H. Allen, Sons and Co., Ltd.,
Queen's Engineering Works, Bedford,
August 10th.

THE ARMAMENT OF CAPITAL SHIPS.

SIR,—Not until recently I have had an opportunity of reading THE ENGINEER's article of May 20th, that dealt in a fascinating manner and substantially with a paragraph from my pen about questions of naval armament, having appeared in the *Marine Rundschau's* May number.

Much pleased as I am to see a paper of THE ENGINEER's mould take such an interest in it, I feel bound to explain for what has apparently been misunderstood, though I must own that the title was perhaps misleading.

I never intended to advocate a reduction in the number of heavy guns in the standard capital ship, where there is ample weight available for the mounting of eight 16in. guns in twin or nine in triple turrets. From my own experience I should always prefer a reserve in guns, as my ship at Jutland was also temporarily reduced to four serviceable heavy guns. It was more to the minor navies I referred, tied in their shipbuilding policy by restrictions either political or economic, and where it is essential to obtain a maximum of fighting power on a relatively small displacement.

When the paper was written I had no knowledge of a possible further decrease in the capital ships displacement being contemplated by the British authorities, nor did I feel a call to advise their naval construction. But with you I am fully aware that a displacement of 20,000 tons will necessitate a reduction either in number or calibre of the standard heavy gun armament.

As to the vulnerability of gun turrets, it is my opinion that the present construction is still far from being ideal, and I venture to hint that the secret lies not merely with the relatively simple but dearly bought measure of thickening armour plating. Such improvements in turret protection might, indeed, I believe, justify a numerical reduction in guns, where essential.

G. PASCHEN (Korvettenkapitän a.D.).

Flensburg-Mürwik, 14 Kelmstr., August 1st.

IN view of the increasing interest in binary fluid prime movers, it is noteworthy that at the end of September the Almaden mercury mines of Spain will be in a position to put 50,000 bottles of mercury on the open market.

2000 K.V.A. PHASE CONVERTER AND STARTING MOTOR

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, PITTSBURG, ENGINEERS

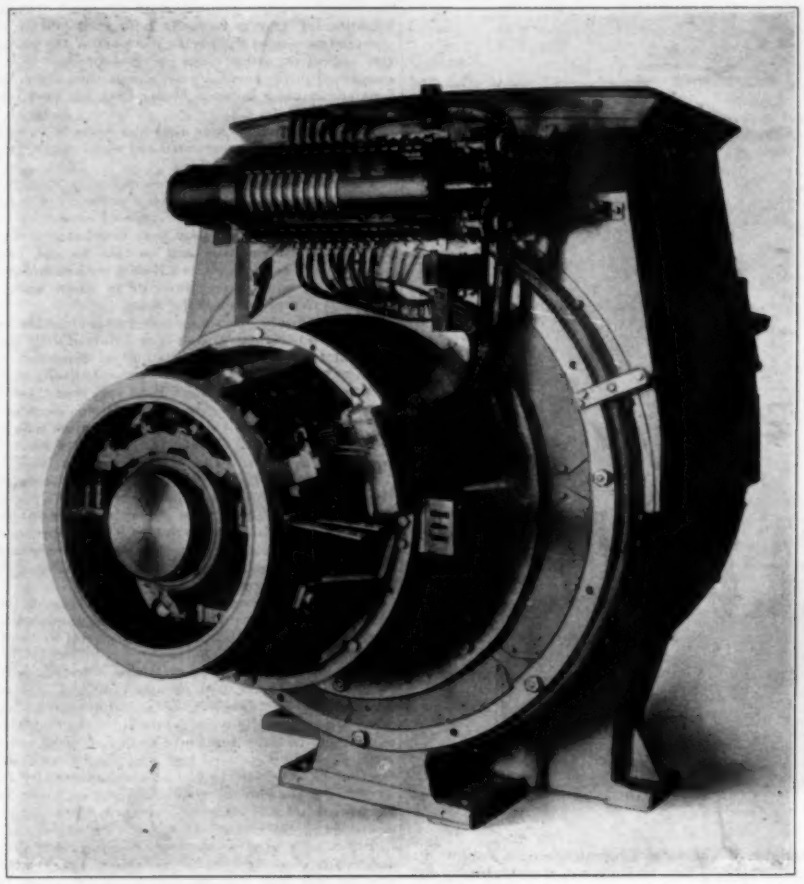


FIG. 1

The Electrical Equipment of the Virginian Railway Locomotives.

In our issue of May 25th, 1925, we published an article on the large electric locomotives built for the electrified section of the Virginian Railway, but on that occasion we did not deal very fully with their electrical equipment, which on account of the size and hauling power of these engines is of exceptional interest. From the Westinghouse Company of America we have recently received a more detailed account of the phase converters and motors with which these engines are equipped, and although such powerful locomotives are never likely to be required in this country, the equipment is well worthy of description. At present the locomotives are made up of three units, although the control gear is arranged so that as many as four units can be operated in multiple by a single driver. As we explained in the article to which we have alluded, power is taken from a single-phase 25-cycle 11,000-volt overhead wire, through an oil-insulated transformer placed in each unit, and the pressure is reduced to suitable values for each piece of apparatus, the available voltages on the secondary of the transformers ranging from 92 to 1500 volts.

The self-ventilated phase converter which is shown in Fig. 1 is designed for a capacity of 2000 kVA, and it runs at a speed of 750 revolutions per minute. It is wound in a similar manner to a two-phase induction motor, and when it has been brought up to speed it operates with single-phase current. Voltage is, however, generated in the second phase, and two-phase current is thus made available. By means of a Scott connection to the main transformer, this two-phase current is turned into three-phase current, which is supplied to the motors that propel the locomotive. A low-voltage tapping on the phase converter in conjunction with suitable tappings on the transformer supply power for the auxiliary induction motors. The phase converter rotor has a distributed winding and the slots are skewed so as to give a voltage wave that is free from ripples, while the winding is arranged so that it serves the double purpose of exciting and damping. Two-piece ring-oiled bearings have been provided, and the bearing caps may be removed and the bearings may be changed without removing the bearing brackets. The system of ventilation is radial, and the exhaust air is carried outside the locomotive by means of ducts.

After the locomotive air reservoirs have been charged the electro-pneumatic switch for starting the phase converter is closed. The switch applies power to the single-phase series motor which is used to start the phase converter and to bring it up to speed. Once the phase converter is running, it continues to run on the single-phase line, and the starting motor is then automatically converted into a direct-current generator for supplying excitation to the phase converter rotor winding, thus causing the phase converter to work with a high power factor. The armature of the starting motor is mounted—as shown in Fig. 1—directly on the phase converter shaft, whilst the stator is bolted to the phase converter frame. Since only two bearings are used, the phase converter occupies the minimum amount of space. As the starting motor brush holder support is open, the brushes can be inspected or replaced with ease, and in a short space of time. The phase converter brush holders, which are used to convey the exciting current to the phase convérter, through two collector rings, are also carried on this brush holder support. Leads to the phase converter rotor winding are brought to the outside through a hollow shaft, which makes it possible to inspect or change the collector rings, brushes and brush holders, without removing any part of the phase converter.

Each locomotive unit has a 2–8–2 wheel arrangement, with a jack shaft, situated between the end driving axle and the pony truck at either end, and each jack shaft is driven by a motor mounted directly above it, the drive being through pinions on both ends of the motor shaft to flexible gears on the jack shaft. In turn, the jack shaft is connected to the drivers by side rods.

One of the traction motors is shown in Fig. 2. It is a three-phase induction motor with a wound rotor and with the stator windings arranged for speeds of 375 and 750 revolutions per minute, corresponding to locomotive speeds of 14 and 28 miles per hour. To obtain these speeds, the stator connections are changed so as to convert the eight-pole winding, which is used for the locomotive speed of 14 miles per hour into a four-pole winding which gives 28 miles per hour. The change is made with only six stator leads, for the rotor is arranged so that it will operate with four or eight stator poles and a rotor pole-changing switch is therefore unnecessary. The motor frames and bearings are supported by rectangular cross ties, which are bolted to the locomotive side frames. Two horizontal seats and a vertical face form part of the cross ties and extend the full distance between the side frames. Each motor frame is bolted to the horizontal seats and against the vertical face, so that it is held rigid in all directions. Skims are employed in order to fix the proper air gap between the stator and rotor. The bearings are held in place by caps which are bolted to the cross ties above each side frame. The split bearing housing construction makes it possible to use two-piece motor bearings, which can be renewed without interfering with the motor pinions or current-collecting gear. Lateral play can also easily be taken up, because the rotor end thrust is taken on the inner end of the motor bearings, which can be shifted in the housings. The bearing shells are flanged so that liners to compensate for lateral wear can be inserted between these flanges and the locomotive side frame. The bearings are lubricated by means of rings from oil wells in the cross ties, each well having a capacity of 2 gallons.

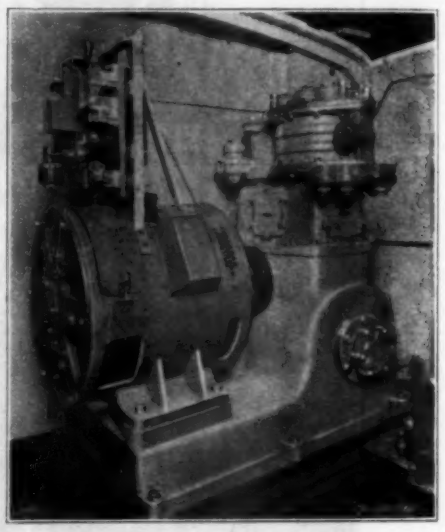


FIG. 3—MOTOR-DRIVEN AIR COMPRESSOR

When starting these locomotives a liquid rheostat is inserted in the rotor circuit, and the resistance is cut out step by step as the engine is accelerated, then, when the locomotive is running at its normal speed the rotors of the motors are short-circuited. Connection is made to the rotor winding through collectors on each end of the motor shaft, and leads run from each collector through the shaft to the winding. This arrangement enables the collectors and brush holders to be placed outside the bearings and pinions, and it makes those parts accessible through trap doors in the locomotive side aisles. Moreover, the current collectors can be removed without lifting the motors from the locomotive. Each of the motors is ventilated by a blower mounted on a rack above the motor, into which air is blown at each end through short steel end bells, whilst the exhaust air is discharged radially into ducts, which carry it outside the locomotive.

On each locomotive unit there are two motors, which

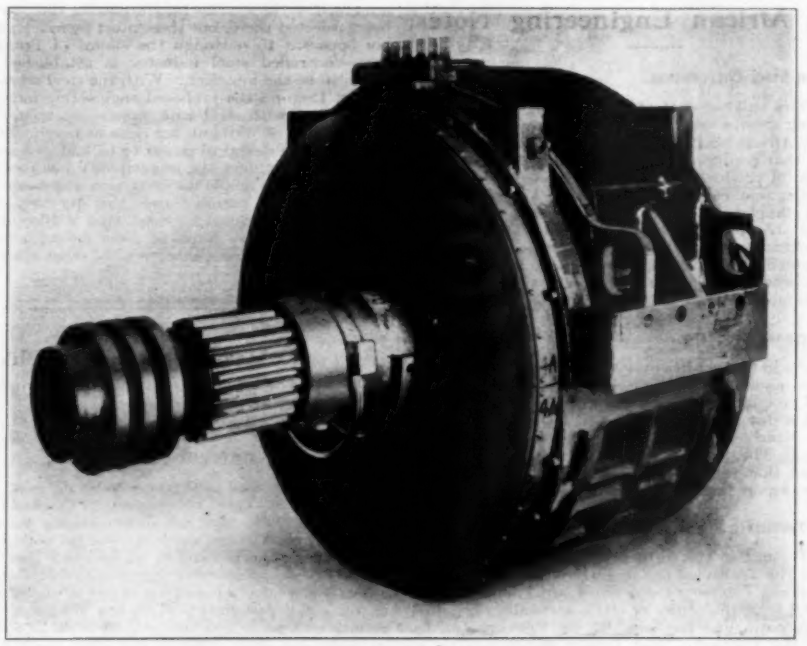


FIG. 2—TRACTION MOTOR FOR VIRGINIAN RAILWAY LOCOMOTIVES

utilise single-phase current directly, one for the air compressor—shown in Fig. 3—and the other for starting the phase converter. The former is a doubly-fed motor running at a speed of 1200 revolutions per minute, and it drives the compressor through a flexible coupling. As soon as the circuit breaker is closed, the motor starts, and it shuts down when the pressure in the air reservoir has reached 130 lb. per square inch. Each compressor has a displacement of 150 cubic feet per minute, and when all three are put into service a locomotive that has been out of use can be made ready for operation in a period of two and a half minutes. Only two of the three compressors on a complete locomotive are, however, used at the same time. The carbon brushes on the compressor motors can be inspected and changed from the locomotive side aisle, whilst the ball bearings which are also used on this and all other auxiliary motors only require attention once a year, and by means of a grease gun system of lubrication, one man can lubricate all the auxiliary motor bearings on a three-unit locomotive in one hour.

With the exception of the compressor motors, all the auxiliary motors are squirrel-cage induction machines, and four machines in each unit have interchangeable parts. These are the two traction blower motors, a pump motor which circulates the electrolyte in the liquid rheostat, and a combined pump and blower motor which circulates the main transformer oil for the cooling radiator and the electrolyte cooling tower. With the exception of the shafts and the pump motor end brackets, all parts of these four motors are the same, and consequently a relatively small number of spare parts is required. The gate valve which controls the height of the rheostat electrolyte is raised and lowered by a sheave wheel mechanism, which is driven by a small squirrel-cage motor. The generator which supplies the current for control purposes is also driven by a squirrel-cage motor, and supplies 32-volt direct-current for the control circuits and for charging the battery.

INTERNATIONAL ELECTRO-TECHNICAL COMMISSION.

THE International Electro-technical Commission will hold a series of meetings, beginning on September 4th, at Bellagio, Lake Como, Italy, when technical committees will discuss the following subjects:—Nomenclature; Symbols; Rating of Electrical Machinery; Commercial and Test Codes for Hydraulic and Steam Turbines; Rating of Rivers; Lamp-holders; Radio Valve Caps; High-voltage Tests for Line Insulators and Electrical Apparatus; Traction Motors; Insulating Oils; Measuring Instruments; Terminal Markings; Regulations for Overhead Lines.

At these meetings, at which a large gathering of those interested in electrical engineering matters from some twenty-five countries will be present, the British electrical industry will be represented by fully qualified engineers in their respective branches of the work. It is of interest to note that international commercial and test codes for hydraulic and steam turbines are to be discussed. As far as the commercial code is concerned, it is hoped that the preliminary work done at The Hague in 1925 and at New York in 1926 may lead to some definite recommendation at the meeting in Italy. In regard to the test code, we note that members of the Heat Engine Trials Committee of the Institution of Civil Engineers will be present at the meetings.

The Italian Committee has arranged for the delegates to make a tour of inspection of important power plants, and to visit some of the most historical cities of Northern Italy. The Italian State Railways are, we understand, providing this tour, together with special facilities for the delegates to travel in other parts of Italy at greatly reduced fares.

LAUNCHES AND TRIAL TRIPS.

EDDYSTONE, steel screw steamer; built by David and William Henderson and Co., Ltd., Partick, Glasgow, to the order of the Clyde Shipping Company, Ltd., Glasgow; dimensions, 270ft. by 37ft. by 18ft. 6in.; to carry passengers and cargo. Engines, triple-expansion, 21in., 34in., 56in. by 39in. stroke, pressure 185 lb. per square inch; constructed by D. and W. Henderson and Co., Ltd.; launch, July 12th.

PETRONELLA, twin-screw motor vessel; built by Harland and Wolff, Ltd., to the order of Anglo-Saxon Petroleum Company, Ltd.; dimensions, 305ft. by 50ft. by 15ft.; to carry oil in bulk. Engines, two sets of single-acting four-stroke cycle six-cylinder Harland-B. and W. motors; constructed by Harland and Wolff, Ltd.; launch, July 12th.

MONAGAS, oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the Venezuela Gulf Oil Company. Engines constructed by Richardsons, Westgarth and Co., Ltd.; launch, July 15th.

KEDAH, twin-screw steamer; built by Vickers Ltd., to the order of Alfred Holt and Co., for the Straits Steamship Company, of Singapore; dimensions, 310ft. by 50ft. 3in. by 41ft. 3in. Engines, two sets of Parsons' turbines and single-reduction gearing, pressure 200 lb.; constructed by the builders; launch, July 16th.

AUGUSTINA, oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Anglo-Saxon Petroleum Company, Ltd.; dimensions, 300ft. by 50ft.; 3600 tons deadweight. Engines, four-cycle, direct reversible, six-cylinder, single-acting marine motors; constructed by R. and W. Hawthorn, Leslie and Co., Ltd.; trial trip, July 28th.

OILSHIPPER, steel tank steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the British Oil Shipping Company, Ltd.; dimensions, 424ft. by 53ft. 5in.; 8800 tons deadweight. Engines, triple-expansion; constructed by the builders; trial trip, July 28th.

CRITON, steamer; built by Wm. Gray and Co., Ltd., to the order of Cie. de Navigation d'Orbigny, Paris; dimensions, 400ft. by 53ft. by 27ft. 6in. Engines, triple-expansion, 26in., 43in., 71in. diameter by 48in. stroke, pressure 180 lb.; constructed by the builders; trial trip, July 29th.

SAN CARLOS, oil tanker; built by Harland and Wolff, Ltd., to the order of the Lago Shipping Company, Ltd.; dimensions, 315ft. by 50ft.; 2400 gross tonnage. Engines, twin-screw, triple-expansion, pressure 180 lb.; constructed by the builders; trial trip, July 29th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

EXTREMELY quiet conditions prevail in the iron and steel industries of the Midlands and Staffordshire. Work has now been resumed at most of the works, but buying of raw and finished material is on the same limited scale as before the holiday break, and there are few, if any, indications of any immediate improvement. Many local trades, however, are fairly supplied with work. Electrical and mechanical engineers are moderately busy, as are rolling stock establishments. Constructional engineers report the receipt of inquiries, which they hope will materialise early in September. The engineering and allied trades of the Midlands keep heavy ironfounders well employed, while slightly improved demand is reported by makers of brass and copper tubes and fittings. Birmingham general brassfounders and stampers find business falling off. A revival of demand for all classes of iron and steel is, however, considered almost certain next month, and producers in this area are anxiously awaiting that time.

Raw Iron.

The pig iron market has no strength, and it is difficult to determine the true state of affairs in this department. Very little business is being done, either in forge or foundry material, and those who anticipated that consumers would come into the market immediately after the holidays with orders for autumn supplies have so far been disappointed. All the efforts of smelters to persuade users that prices have reached bottom have not availed; they are still sceptical, and until they are convinced that there is nothing to be gained by waiting, they will not place orders. Midland blast-furnacemen this week quoted Derbyshire No. 3 foundry at £3 7s. 6d. and forge £3 4s. Northamptonshire makers asked £3 2s. 6d. for foundry and £2 17s. for forge. North Staffordshire foundry quotations were steady at £3 6s. Blast-furnacemen in this district express an intention of closing down rather than selling below these figures. There is very little foreign iron coming into the Midlands, though reports that it is seriously competing with Cleveland makes, which are obtainable at £3 5s., are current. Makers of hematite are able to dispose of the present limited output, but have large stocks of iron which they are willing to sell about 1s. below the current price of £3 16s. Midland pig iron makers do not view the immediate future with any degree of satisfaction or any great hopes, but consider September should witness a revival of demand.

Steel.

There has been no reinvigoration of steel demand, and orders for finished steel do not come in sufficiently fast to balance output. Midland constructional engineers have a fair amount of work on hand, and small jobs are being booked regularly. The tonnages required by them are small, if numerous. Large contracts are absent from the market. For joists and sections the quotation of £7 12s. 6d. per ton is maintained. The usual figure for ship, bridge and tank plates is £8 7s. 6d., but some rollers regard this figure as unremunerative and are unwilling to accept orders on that level. Boiler plates continue to be variously quoted £11 to £11 10s. Staffordshire hoops are firm at £10 10s. at works. Small steel bars sell at £7 15s. upwards, but there is very little business passing in billets, even at £6 10s., which appears to have become the generally accepted basis. Steel scrap is a lifeless market, and buyers can practically command their own terms. For turnings, £2 7s. 6d. to £2 10s. delivered South Wales is the figure mentioned. Throughout all departments of the steel trade there is a tendency to withhold business pending lower prices, and price concessions from the Steelmasters' Association are claimed to be assured in the near future, consumers affirming they will not buy until some reductions have been conceded.

Staffordshire Bars.

The Staffordshire bar iron trade shows no signs of improvement. Most of the mills have now resumed, but there are no great reserves of orders. Mills producing marked bars have some reserve of work in hand, but makers of Crown and common bars stand badly in need of work. The lowering of the basis for marked bars from £14 10s. to £13 10s. at the beginning of June is the primary cause, presumably, of the fall in the average net selling price, which justifies the 5 per cent. wages reduction in ironworkers' wages controlled by the Wages Board sliding scale. The new rate, which is still 42½ per cent. above the base rate for puddling, came into operation on Monday. This is the third drop in ironworkers' wages since April, and makes a total of 12½ per cent. Manufacturers of nut and bolt bars do not look for a material accession of business in face of continental prices, which are roughly £3 15s. a ton under those quoted by Staffordshire makers. Belgian iron was offered on 'Change to-day at £5 17s. 6d. delivered in the Black Country.

Galvanised Sheets.

Galvanised sheet mills are urgently in need of fresh contracts, and though 24 gauge galvanised corrugated sheets are generally quoted £14 f.o.b., it is stated that for a tempting order that figure might be cut. Indeed, there were on 'Change in Birmingham to-day merchants who claim to have arranged sales at £13 17s. 6d. The home demand is quieter than before the holidays, and calls from overseas are spasmodic.

Declining Exports.

Midland industrialists are extremely perturbed by the serious position revealed by the President of the Board of Trade just prior to the prorogation of Parliament. They had scarcely realised the fact that we are now exporting not more than 78 per cent. of the manufactured goods we did fourteen years ago, while our resources have increased enormously in consequence of new works and new plant started during the war period. Sir Robert Horne's statement regarding steel, which is of great importance to the Midlands and other metal-producing districts, was equally disquieting, showing as it did that whereas we at one time sent abroad three times as much as we imported, for the first five months of the current year we imported 2¼ millions and exported only 1½ millions. These facts cannot be regarded with anything but concern, and industrialists hereabout are unable to prescribe a remedy unless, as some suggest, it lies in fiscal readjustments.

Birmingham Exports to U.S.A.

Exports to the United States from the Birmingham consular district during the second quarter of the current year compare very favourably, in some instances, with those of the corresponding period last year; in others there has been a decline. Metal manufactures show a shrinkage from 149,224 dollars to 125,324 dollars, and iron and steel manufactures from 127,292 dollars to 114,619 dollars. Steel sashes rose nearly 5000 dollars to 71,222 dollars, but pens fell from 120,302 dollars to 69,040. Machinery and vehicles, a category which includes motor cars and motor cycles, decreased from 58,927 to 39,287 dollars. There was also a drop in brass manufactures from 68,778 to 35,592 dollars. There was a drop from 186,244 dollars to 151,947 dollars in the value of needles exported.

Rolling Stock Contract.

Much satisfaction was expressed in Midland engineering circles when it became known that the Vickers Metropolitan Carriage (South Africa), Ltd., on behalf of the Metropolitan Carriage, Wagon and Finance Company, of Saltley, Birmingham had secured the tender for thirty-seven railway coaches for the South African Railways at a price of £132,847. It is understood that twenty-four firms, including several foreign ones, sent in tenders, and to have secured the contract in face of this competition is a praiseworthy achievement. Considerable pleasure is derived from the announcement that the coaches will be manufactured at Saltley.

Canal Bridges.

Since I last wrote representatives of the Birmingham City Council and the Warwickshire, Worcestershire and Staffordshire County Councils, together with representatives of several of the smaller local authorities concerned, have considered the position in relation to the desired modernisation of canal bridges in the area with a view to making them safe for heavy traffic, but no decision has yet been arrived at. The conferences being held are considering the Ministry of Transport's suggestion that the Midland local authorities should propound a scheme, and, subject to its approval, the Ministry would be prepared to give a grant towards the cost of putting these bridges into a state to meet present-day requirements. The contribution suggested is a maximum of 65 per cent., or a minimum of 50 per cent. of the total cost. The difference would have to be found by the local authorities, with the possibility of a contribution from the canal company which would relieve them of their liability.

Black Country Miners' Wages.

At a meeting of the Joint District Board for the South Staffordshire and East Worcestershire Coalfield it was reported that the ascertainment for July showed that the wages payable for August, September and October were 136·19 per cent. on the 1911 basis. The effect of the ascertainment is a further reduction in miners' wages, which now fall to the minimum, this being 140 per cent. on the 1911 basis.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Industry and Local Taxation.

SOME discussion has taken place here within the last few days of the enormous burden of local taxation on industrial overhead charges, with particular reference to the position of cotton textile mills, many of which were recapitalised during the boom of 1919 and 1920. In these cases reassessments were made on the basis of the new capital values of the mills, with obvious serious consequences. It may be recalled that the Manchester Chamber of Commerce some months ago took the practical step of approaching the financial authorities of the city and placing before them facts and figures relating to local taxation and its effects on various branches of industry, including engineering. Mr. Daniel Adamson, who is well known in engineering circles in the North of England, has taken up the case on behalf of industries other than those concerned with the manufacture of cotton textiles. The burden of taxation, and particularly of local rates, he points out, lies as heavily on other staple industries as upon the cotton trade, and is likely to do until the need for economy in municipal management is realised by those who have the power to alter things through the ballot box.

The Railway Carnival.

Preparations for the Railway Employees' Carnival, promoted by the Railway Film Association, and to be held in the Belle Vue Gardens, Manchester, on September 24th, are now approaching completion. Several features, apart from those usually associated with carnivals, are being arranged. It is hoped, for example, weather conditions permitting, to take a film dealing with the evolution of the vacuum brake from the days of Otto von Guericke's experiments in the fifteenth century up to the present time. The carnival itself is a one-day affair, but a Railway Exhibition is being organised by the Committee

in which British, South African, Canadian, Australian, New Zealand, and Indian railways are co-operating, and various interesting exhibits have been promised. The Exhibition, which is to be held in the large Exhibition Hall at Belle Vue, will continue for a week.

A Cheshire Electricity Scheme.

The proposed purchase of the Alderley and Wilmslow Electricity Supply Company, Ltd., is the subject of an application for approval by the Alderley Edge (Cheshire) Urban District Council to the Electricity Commissioners. It is proposed to set up a Joint Board to include the urban districts of Alderley Edge and Wilmslow and the surrounding districts.

Non-ferrous Metals.

The see-saw in the non-ferrous metal markets still goes on. In most instances the reaction after the all-round advance noted a week ago has been severe, and in the case of copper, lead and spelter values at the moment of writing are lower than they were before the rise took place. Tin, also, has lost ground on balance, but to a relatively less extent than the others. As I pointed out last week, the expected reduction in tin stocks, subsequently confirmed by the July month-end statistics, had already been fully discounted at the figures then ruling, and a setback is not a matter for surprise. As it is, cash metal has given way only to the extent of about £2 a ton compared with the advance in the previous week of rather more than £7, the fall in forward tin being roughly £1 a ton. Speculative business still accounts for the bulk of transactions in this section of the market. Trade demand for copper has not been particularly active from consumers in this country, and the same may be said of lead and spelter. With a certain amount of selling pressure in evidence values in each instance, as stated above, have lost all the ground previously gained.

Iron.

A feature of the pig iron market that may be said to favour business when buyers make up their minds to buy is the steadiness that prevails in respect of pretty well every variety. Up to the present, however, there has been no perceptible improvement in the demand in spite of the fact that what are regarded as two of the quietest weeks of the year have passed. Little more than the small-scale operations that can be met with at any time have been in evidence during the present week, and although there have been occasional reports of bookings for two or three months ahead, they have been of minor importance, most of the orders that have been placed being for small quantities for early delivery. In nearly every case current values have been maintained at round the levels last reported, Scottish foundry iron, which has given way a little, being the one exception. The last named can now be bought on this market for delivery Manchester or equal distance at about 93s. 6d. per ton, a figure which is actually lower than at the end of April of last year before the outbreak of the general strike, notwithstanding the substantial increase in railway charges on pig iron sent from Scottish furnaces into this area. Other makes keep steady at 75s. 6d. for both Staffordshire and Derbyshire, 83s. 2d. for Middlesbrough, and 89s. for hematite, all delivered. Lancashire Crown bars are unchanged at £11, and second quality bars at £10 per ton, and the demand is still on very moderate lines.

Steel.

In the steel market the position, so far as buyers is concerned, is still largely one of "sitting on the fence" and awaiting price developments. Users of steel are as firmly convinced in their expectations of concessions sooner or later as makers are vehement in their protests that present quotations leave no margin for reductions. The position is thus more or less one of stalemate, with actual business at a minimum, and market conditions, if they favour one side or the other, favouring the "bears." Boiler plates are still offered at £11 5s. to £11 10s.; general plates at £8 7s. 6d.; joists and sections at £7 12s. 6d.; and steel bars at £7 17s. 6d. to £8 12s. 6d., according to size. The demand for foreign steel materials is equally slow at the moment, and few orders of any weight have been booked this week. Values are therefore nominally unchanged at £7 10s. for Siemens plates; £7 4s. for ordinary plates; £5 15s. for steel bars; £5 2s. 6d. for billets; £5 7s. for sheet bars; and about £5 15s. per ton for joists and sections, these prices including delivery to works in the Lancashire district, for cash against documents.

BARROW-IN-FURNESS.

Hematites.

The run of business in the hematite pig iron trade of North Lancashire and Cumberland is very small. Whatever may be the requirements of users they are only inclined to place contracts to cover their immediate wants. Forward delivery business is altogether in the background. It was expected that some better trade would follow the cuts in prices, but there has been no move in that direction. Locally, there is a steady call for iron on the part of Workington and Barrow steel makers and the two furnaces damped down at Barrow are again in operation.

Iron Ore.

The demand for iron ore is largely a local one except for the higher grade metals such as those raised at Hodbarrow, for which there is a trade with outside smelters. At several of the mines the men are on short time. Foreign ores are being imported.

Steel.

The general demand for steel is slow. Orders for rails are difficult to secure, and the contracts at Barrow and at Workington are not too heavy. Hoops are a good steady trade, the demand being largely on overseas account. At Workington a good order has been received for steel sleepers for Egypt, and it will keep that department busy for six months to come. The steel departments at Barrow and Workington resumed work after the holidays on Monday last.

Fuel.

The demand for fuel is on the quiet side, both as regards coal and coke.

SHEFFIELD.

(From our own Correspondent.)

State of the Steel Trade.

THE open-hearth steel plants of the district kept running on a very fair scale during most of the holiday week, and are still maintaining a considerable measure of activity. At Penistone, Parkgate, and Vickers' works, the plants are working almost up to full capacity. At other establishments the proportion of employment is not so large, but still the aggregate output of material is on a fairly high level. The arrears of work that accumulated during the coal strike have now been cleared off, however, and contracts recently placed are hardly sufficient to keep production at its present rate. It is hoped that it will not be found necessary to reduce output, but not much in the way of revival is expected during the present month, although there is a good deal of optimism with regard to the prospects of a general buying improvement setting in during September.

Railway and Engineering Work.

The work on hand in the railway steel departments includes axles and tires for South America, but the quantity coming from overseas markets at present is much below the pre-war average. The requirements of the electrical and motor industries continue to provide a large amount of work for several firms. In the tool steel branch a good deal of depression, which mainly affects the smaller firms, is reported. There are a few notable exceptions, owing to overseas contracts for engineering requirements. Stove grate makers are far from well employed, but producers of builders' ironwork keep fairly busy.

Cutlery and Plate.

In these trades conditions vary considerably. A good many contracts are on hand for the equipment of hotels and steamships, and firms executing them are fairly well situated, but those depending mainly on general trade are not finding employment satisfactory. There has been a decline in the colonial demand. The sections producing hollowware and high-class gift goods are not enjoying much activity, and the prospects of these branches are not considered favourable, as the trade is being affected by changes of fashion and taste as well as of domestic habits. There is still a fair demand for stainless cutlery, but price competition is very keen.

Some Good Contracts.

The London and North-Eastern Railway Company, which had been experimenting with improved steam rail-cars in order to meet the public need for more intensive passenger services, has decided to place orders forthwith for twenty units of the Sentinel-Cammell type, and also for four super-Sentinel locomotives. Further orders for thirty units, of either the Sentinel-Cammell or the Clayton type, are in contemplation, but have been deferred pending further experience of certain mechanical improvements. The Glasgow Corporation has placed with Edgar Allen and Co., Ltd., Sheffield, an order for several special tramway track lay-outs of the firm's manganese steel. Brown Bayley's Steel Works, Ltd., Sheffield, and Samuel Fox and Co., Ltd., Stocksbridge, have received an order from the Crown Agents for the Colonies for railway tires. A contract has been booked by the Metropolitan-Vickers Electrical Company, Ltd., for the main switchgear and a considerable amount of auxiliary apparatus for extensions to the Portobello power station of the Edinburgh Corporation.

Local Water Questions.

The sale of the Duke of Rutland's Longshaw Moors, on the Yorkshire and Derbyshire borders, is being taken advantage of by several public authorities for waterworks purposes. The Sheffield Corporation was early in the field, and acquired about 3000 acres, through which the Burbage Brook runs; Chesterfield Corporation secured 1400 acres, and Baslow Urban Council 400 acres. Now, the Chesterfield Rural District Council, in order to preserve the water rights at Barbrook and Ramsley reservoirs, has purchased close upon 5000 acres of the moorland for £25,920. In order to meet the need for an additional water supply at Rawmarsh, brought about by extensive building, the Rawmarsh Urban Council has constructed and opened a new reservoir on Haugh-road. It will be used for pumping water from the Rotherham supply, and has a capacity of 500,000 gallons. Great difficulty is being caused by water shortage on the borders of Notts. and Derbyshire. At a meeting of the Blackwell Rural Council the Clerk stated that the recent shortage was the worst ever experienced in Blackwell and South Normanton, and the position became so acute that they asked for assistance of the Ministry of Health. They also applied to the Mansfield Corporation to assist them temporarily to the extent of anything from 25,000 to 50,000 gallons per day when necessity arose, but Mansfield declined, as it was expecting heavier calls upon its wells in the near future. The Warsop and Blackwell councils have now prepared a scheme which is before the Advisory Committee, and which, if carried out, will supply the needs of a wide area for some years.

Omnibuses to Replace Trams.

After an experience of more than twenty years, the last seven of which have been financially unsuccessful, the Lincoln City Council has decided to discontinue its tramway service and to run instead an increased omnibus service. It has been resolved to give three months' notice and then to apply to the Minister of Transport for an order declaring that the powers of the Council in respect of tramways have terminated, provided that the Minister will make a grant towards the cost of making up the highway in High-street, and that the necessary borrowing powers can be obtained.

Personalia.

A figure which was very well known in the steel trade circles of Sheffield for many years was removed last week by the death, at the age of seventy-six, of Mr. A. G. M. Jack. Mr. Jack joined the staff of Hadfields, Ltd., in 1888, and was with the firm thirty-three years, being in turn works manager, general manager, director, managing director, and deputy chairman, retiring in 1921. Mr. Jack served his apprenticeship in the engineering department at Woolwich Arsenal. At the age of twenty-two he joined the United States Navy as an engineer, and two years later he erected and set to work the Nai-Kuang Sze Arsenal, near Tientsin, North China, where he remained six years. He was one of the few Englishmen who could speak and write Chinese fluently. The directors of Thos. Firth and Sons have appointed to a seat on the board Mr. John Firth, a grandson of Mr. Mark Firth, one of the founders of the firm. Mr. John Firth has previously been the secretary of the company. Captain T. E. Crease has been appointed a director of John Brown and Co., Ltd. He has been connected with the company at their London office for some years, and has already done good work as a special director.

NORTH OF ENGLAND.

(From our own Correspondent.)

Two More Furnaces Blown Out.

THIS week Pease and Partners, Ltd., have put two blast-furnaces out of operation at their Tees Ironworks, Middlesbrough, and, as a consequence, the ironstone mines at Boulby and Great Ayton, belonging to the same firm, have been closed down. This development reflects the difficulties which are being encountered by the Cleveland iron trade at present owing to the severity of continental competition. Pease and Partners, Ltd., have three blast-furnaces at their Tees Ironworks, only two having been working lately. One has been making Cleveland iron and the other hematite. The vast stocks in the district have continued to accumulate, in the absence of adequate orders, at a rate which has foreshadowed a curtailment of operations, and incidentally an increase in unemployment, for several weeks past. As a result of the Tees Ironworks furnaces being blown out, the number of blast-furnaces continuing in operation on the North-East Coast has been reduced to 37, as compared with 38 before the coal stoppage of last year, and a normal number of approximately 72. Ten blast-furnaces have been put out of commission since the beginning of May—an eloquent commentary on the present situation of Cleveland's staple industry.

Iron and Steel Imports.

The severity of the foreign competition is reflected in the statistics issued this week by the Tees Conservancy Commissioners showing the imports of foreign iron and steel into the river Tees. For the nine months ended July 31st, 306,418 tons of foreign iron and steel were imported into the district, double the tonnage for the corresponding period of 1925–26 and six times that of the pre-war period. As showing the great inroads which foreign competition has made into the Cleveland district, in the nine months of the pre-war period only 312 tons were imported, whereas a year ago the tonnage was 40,074, and for the last nine months the quantity has increased to 94,977 tons.

Cleveland Iron Trade.

The outlook in the Cleveland pig iron trade is still gloomy and discouraging. Negotiations to cover fall-of-the-year requirements are almost due, and hope is entertained that a fair number of orders will shortly be placed, but anything like brisk autumn trade is not looked for. Continental competition continues keen, though it is reported that manufacturers abroad have sold certain commodities fairly heavily, and are somewhat less disposed to cut prices. There is, however, still a gap of about 5s. between the prices of Cleveland and continental pig iron. The limited production of Cleveland pig iron is not fully taken up, and even with the blowing out of the two furnaces already mentioned it is feared that stocks will continue to accumulate. Prices are unchanged, No. 1 Cleveland foundry iron being 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d. per ton.

Hematite Pig Iron.

In the East Coast hematite pig iron trade ruling quotations are altogether unprofitable, and are unlikely to be reduced further. Inquiry is just a little better, and a few home and export orders are reported to have been secured. Mixed numbers are in the neighbourhood of 75s. 6d., and No. 1 grade is put at 76s. Hematite is thus comparatively cheap, mixed numbers being about 5s. 6d. above the price of No. 3 Cleveland, whereas under normal conditions the difference is 8s. to 10s.

Ironmaking Materials.

Consumers of foreign ore have large and increasing stocks, and are still holding off the market. Sellers base quotations nominally on best Rubio at 21s. per ton c.i.f. Tees, but it is difficult to ascertain on what terms contracts might be arranged. Durham blast-furnace coke makers are endeavouring to stiffen prices, but ironmasters report that requirements can still be readily covered at 19s. per ton for good average qualities delivered at the works.

Manufactured Iron and Steel.

In the manufactured iron and steel trade new business is scarce, and declining shipments on current

contracts are foreshadowed. An impression has existed in certain quarters this week that prices may ease a trifle, but as the next meeting of the Manufacturers' Association does not take place until September, this supposition would appear to emanate from sources outside the Association.

The Coal Trade.

The position in the Northern coal trade is not quite so firm as it was a week ago. A good many inquiries, however, are circulating, including two or three for large quantities of special gas coal; and on this account, and because of a fairly sound prompt position, the tone is mainly steady. Yet the slower turn in fresh coal business has been enough to stay the upward course of values, and actual realisable prices of various lower grade coals are lower. The situation, however, is irregular, and there are collieries which have a well-filled turn book to the end of the month. Best Northumberland steam coals are so placed, and merchants ask not less than 14s. 3d. for additional supplies. The direct quotation is higher by threepence, but there is not much coal for disposal in this channel. Other large steams are quietly steady, but smalls are a poor feature. Best and special gas coal is moderately booked and in some demand, but second gas, coking and ordinary bunker fuel is in ample supply. There is little high-class bunker coal on sale for prompt loadings. The feature of the market is the steady pressure for gas coke, considerable quantities having been sold for shipment abroad, and buyers find some difficulty in covering their commitments. First-hand sellers have little to sell for some weeks ahead, and second-hand holders, whilst quoting freely, hold firmly to 21s. Patent cokes move steadily at 18s. 6d. to 20s. for ordinary classes. Beehive is in moderate supply at 27s. 6d. to 32s.

Coal Trade's Parlous Position.

The parlous position of the coal trade in Northumberland may be gauged from expert deductions on the recently announced ascertainment for miners' wages payable this month. These, based on the June figures, showed a percentage of 33 per cent. on basic wages, as compared with the previous month's figures, 34·37. As the minimum under the county agreement is 80 per cent., however, that percentage will be paid by the coalowners. Put in another way, there was a deficit on the month, which has to be made up, of £126,761, and that is the sum which would be required to pay this 80 per cent. The future is mortgaged to that extent; while unfortunately there was a previous deficit of £312,873, so making the total deficiency £439,634. The actual trading loss for June was £76,680, representing a loss for the month of 1/5·80 per ton. In Durham county there was a loss in the trading account of £157,771, which is equal to 1/1·43 loss on every ton that has been raised in the county. Further, the accumulated deficit owing to the owners for making up wages from what the industry had earned to the minimum of 89 per cent. now stands at £1,240,847.

Iron Trade Wages.

Under the official ascertainment prepared for the purposes of the North of England Manufactured Iron Trade sliding scale there will be a reduction of 5 per cent. in puddling and other forge and mill wages as from August 1st.

SCOTLAND.

(From our own Correspondent.)

Slow Progress.

THE holidays are over and the steel and ironworks and the collieries are in operation again. Since the resumption of work business has been slow and markets quiet, and there is little, if any, indication of an early improvement, apart from a slight movement in the export coal trade.

Shipbuilding Contracts.

Barclay, Curle and Co., Ltd., of Glasgow, have received an order to construct two fast cargo steamers on behalf of the Hain Steamship Company, Ltd., Cardiff, which is one of the lines in the P. and O. group of shipping companies.

Steel.

There is a dearth of new business for almost all descriptions of steel material, plates and sections being especially dull. Steel sheet makers are not busy, but anticipate a modest revival in the early autumn.

Galvanised Sheets.

Forward buying in galvanised sheets, in anticipation of higher prices, has been more in evidence of late. In some cases bookings extend to the end of the year. Spelter has risen in price, and in all probability the cost of continental semis will soon show an upward trend.

Pig Iron.

Pig iron continues easy in tendency, and with regard to foundry qualities in particular the position is made more difficult by keen continental competition and arrivals from India. Continental foundry is obtainable at about 67s. 6d. per ton delivered, compared with 77s. 6d. per ton for home foundry No. 3, and many buyers naturally prefer the former. Hematite is in ample supply to meet all demands.

Bar Iron.

The market for bar iron remains inactive. Steel bars suffer from foreign competition. A good inquiry for reinforcing bars has been reported.

Scrap.

The plentiful supply of pig iron has reacted against the market for scrap material, prices of which are most unsteady.

Imports and Exports.

Over 30,000 tons of iron ore arrived at Glasgow during the past week or so, also 2500 tons of pig iron from Calcutta. Exports include 4000 tons of iron shipped to the Colonies, Japan, Java, China, South America, and the Persian Gulf. Large consignments of machinery have been shipped abroad.

Coal.

Though business has not expanded to any extent, better foreign inquiries are reported, and the tone of the market is somewhat firmer. Many collieries pursue the policy of requiring merchants committed to deliveries of industrial smalls to include a proportion of round fuel with each delivery, and this also has had a slight effect on prices. On the other hand, apart from Lanarkshire splints, which are booked ahead for some weeks, stocks of round fuel are generally ample, and some difficulty may be experienced in forcing a higher level of prices. Fifeshire and Lothian steams have better inquiries, but ample stocks. Washed materials are firm in all districts. Aggregate shipments amounted to 215,592 tons, against 189,650 tons in the preceding week and 202,368 tons in the same week in 1925.

Miners' Wages.

Wages of miners in Scotland during August will remain at the minimum, which is approximately 8s. 4½d. per shift. The accountants' report indicates a gross deficiency of £80,000 at least during the period reviewed.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE conditions in the steam coal trade have been rather of a featureless character during the past week, and there is no sign of any immediate material expansion of trade. A number of collieries did not resume work at all last week, but, even so, the supplies of coal have been fully equal to requirements. The tonnage position has been far from satisfactory for collieries, as at the end of last week there were as many as thirty-five idle loading berths at the various South Wales ports, and arrivals of steamers over the week-end were insufficient to alter the position to any great extent. Still, the situation should improve, as there is a fair amount of tonnage due to come along. So far as orders are concerned, these are somewhat slow, and no big inquiry has come on the market since prior to the August Holidays. Most of the leading collieries are moderately well booked up, but there is no difficulty in buyers arranging further supplies for early shipment at last prices. Naturally, the holidays adversely affected shipments last week, the total amounting to 346,957 tons, which compares with 450,428 tons for the preceding week.

Coal Bunkering.

The Great Western Railway Company has adopted measures calculated to develop the coal bunkering trade at South Wales ports. In a communication to the South Wales Coal Exporters' Association, Mr. C. S. Page, the chief docks manager of the G.W.R., stated that representations having been made as to the need for the provision of special facilities for vessels calling for bunkers only, the company has arranged that at each of the principal ports one berth will be specially allotted for that purpose, and to that extent such vessels will have a preferential right to a berth, but it is understood that when this berth is not required for bunker vessels, it will be used for other vessels. This new arrangement comes into operation forthwith. The letter of Mr. Page further stated that the company is exceedingly anxious to afford the utmost facilities to vessels, and it is felt that by a closer co-operation between the traders and the company greater advantage should accrue. For instance, it does happen that one port is particularly busy, whilst another port is slack, and has berths available, but if traders will give the dock managers at the ports at which their vessels are expected as timely notice as possible of the expected arrival of the boats, the dock managers will, by an exchange of information as to the position at each port each day, be able to advise traders if delay is likely to arise, and suggest the diversion of the vessel to another port to get a prompt berth. On the latter point, the directors of the Coal Exporters' Association, in a letter to the members, state that they have suggested that the best use of local docks will not be possible until vessels are allowed to change docks without having to pay double dock dues, as at present.

Spain and Coal Imports.

The news to hand that regulations governing the importation of coals into Spain are to be tightened up is regarded very seriously on the Cardiff market. More details are awaited, but it is gathered that the intention is to institute a system of licensing coal imports, the same as operates in France, and by controlling supplies make it possible to effect the purchase of foreign coals through a central agency.

Docks Traffic.

The returns issued by the Great Western Railway Company respecting the trade at the docks in this district under its control for the four weeks ending July 10th last disclose the depression existing. Imports came to 449,396 tons and exports to 2,515,985 tons, which compare with 518,173 tons and 2,494,773 tons respectively for the preceding four weeks, the net decline therefore being 47,565 tons. For the whole of this year to July 10th the total volume of trade, comprising imports and exports, is 20,519,542 tons, which compares with 14,300,772 tons for the corresponding period of last year, when, of course, trade was adversely affected by the national coal stoppage.

Steel and Tin-plate Trade.

The conditions in the steel and tin-plate trades have not greatly changed, and continue to leave much to be desired, but at the same time it affords some satisfaction to find some works restarting. It is reported that ten mills in the tin-plate section at the Duffryn Steel and Tin-plate Works, Morriston, as well as the steel department restarted in the early part of this week. Serious trouble was threatened last week-end at Messrs. Richard Thomas and Co.'s South Wales steel works at Llanelly, where strike action on the part of five mill engine drivers might result in about 500 workmen being thrown out of employment. The trouble arose over an arbitration award governing tonnage rates. These five men protested against acceptance of the award, but their action in striking was quite unofficial. Fortunately, the trouble was of very short duration, as on Monday the five men sought an interview with the management, and intimated their willingness to resume under the terms of the award. Arrangements were then made for the lighting up of the furnaces, and work was resumed on Tuesday.

Tin-plate Wages.

At a meeting of the Joint Standing Committee of the Industrial Council of the tin-plate industry at Swansea on Tuesday, the employers agreed to the application that the *ex-gratia* bonus should be 7½ per cent. to adult males and 3½ per cent. to process men on condition that no new claims should be advanced in three months. This was accepted by the men's side.

New Tonnage.

Sir William Seager and Sons, who are the managers of the Tempus Shipping Company, of Cardiff, have contracted for a new cargo steamer of about 9000 tons deadweight to be delivered next year. This brings up the list of new tonnage ordered since November last by Cardiff owners to twenty-seven, of a total deadweight capacity of 219,850 tons. It is also announced that Mr. Daniel Radcliffe, head of the Cardiff firm of shipowners of Evan Thomas, Radcliffe and Co., is contracting for additional tonnage, the engines of which will be supplied by the Stockton firm of Blair and Co.

Current Business.

Although the steam coal market displays practically no alteration, so far as prices are concerned, there is slightly more business passing for early loading, which is very welcome to collieries. Small coals are relatively steadier than large coals. The fact is that these qualities are not so freely obtainable, owing to many collieries not being able to work fully on account of the shortage of orders for large. Patent fuel manufacturers are fairly comfortably placed at the moment, but the demand for coke for export is for the time being very quiet. The pitwood market remains dull.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE THAMES TUBE AND FITTINGS COMPANY (GREAT BRITAIN), Ltd., of Crown Works, Lots-road, London, S.W. 10, asks us to announce that it has been formed to carry on the business of Norman Pearson and Co., Ltd., which it is now doing at the address given.

L. WEEKES (LUTON), Ltd., asks us to announce that its London address is now 109, Kingsway, W.C. 2, its London agents, Messrs. Dryden, Osborne and Co., having removed from Craven House, Kingsway, to larger offices. The telephone number is Holborn 1091. Telegrams, "Dryosbo, Westcent, London."

RANSOMES AND RAPIER, Ltd., Ipswich, who have been the sole manufacturers of the Ransome concrete mixers since 1907, ask us to announce that they have recently acquired the selling rights, patents and goodwill of the Ransome Machinery Company (1920), Ltd., and will accordingly market the mixers themselves in future.

JOSEPH EVANS AND SONS (WOLVERHAMPTON), Ltd., of Culwell Works, Wolverhampton, ask us to announce that their London address is now 109, Kingsway, W.C. 2. Telephone, Holborn 1091; and telegraphic address, "Dryosbo, Westcent, London, their agents, Messrs. Dryden, Osborne and Co., having moved to that address from Craven House, Kingsway.

ALLDAYS AND ONIONS, Ltd., of Great Western Works, Smallheath, Birmingham, ask us to announce that the company, which has recently been known as "New Alldays and Onions, Ltd.," has now reverted to the original name of Alldays and Onions, Ltd., and will no longer use the prefix "New," which was temporarily added to the name in 1925 when other businesses were incorporated with it.

CATALOGUES.

THE GENERAL ELECTRIC COMPANY, Ltd.—The Oaram G.E.C. bulletin for July.

WM. ASQUITH (1920), Ltd., Halifax, Yorks.—Pamphlet, "Notes on Drilling."

GARE-CRELLIN COMPANY, 3–4, Clements-inn, W.C. 2.—Pamphlet on "Crellin Highway Motor Yacht."

REAVELL AND CO., Ltd., Ranelagh Works, Ipswich.—Pamphlet No. 151 on "Reavell" portable air plant.

JOSEPH ADAMSON AND CO., P.O. Box 4, Hyde, Cheshire.—Pamphlet, entitled "Waste Heat Boilers for Steel Works."

PETTERS Ltd., Westland Works, Yeovil.—Catalogue giving full particulars of the firm's "S" type surface ignition oil engines.

A.M.I.E.E. EXAMINATION.—The next examination will be held on October 26th, 27th, and 28th, 1927. Candidates must be either students or graduates of the Institution or have lodged with the secretary a duly completed form "E" for election as associate member. Entry forms for the examination, which must be completed and returned by September 1st, and particulars regarding election to membership of the Institution may be had on application to the Secretary, the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 18 0 to 3 19 0	
No. 1 Foundry	3 19 0 to 4 2 0	
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 15 6	3 15 6
No. 1	3 16 0	3 16 0
Cleveland—		
No. 1	3 12 6	3 12 6
Silicious Iron	3 12 6	3 12 6
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 8 6
Mottled	3 8 0	3 8 0
White	3 8 0	3 8 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
" " Foundry	3 5 0 to 3 6 0	
(3) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 0	—
(3) Derbyshire—		
No. 3 Foundry	3 7 6	—
Forge	3 4 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 6 6	—
No. 4 Forge	3 5 0	—
Basic	3 7 6	—
(4) N.W. Coast— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 9 6 (a) / 4 12 6 (b) / 4 16 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 15 0	10 10 0
Best	—	
N.E. Coast—		
Iron Rivets	12 5 0	—
Common Bars	11 5 0	—
Best Bars	12 5 0	—
Lancs.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
Midlands—		
Crown Bars	10 10 0 to 10 15 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 10 0 0	
Gas Tube Strip	11 17 6 to 12 0 0	

STEEL.

	(5) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ¾in. and up	8 2 6	7 12 6
Sections	7 12 6 to 7 15 0	7 2 6
Steel Sheets, under 3/16in. to ¼in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	— £14 0 0 to 15 0 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	
Billets	7 10 0 to 10 10 0	
Manchester—		
Bars (Round)	8 12 6	—
" (Small Round)	7 17 6	—
Hoops (Baling)	11 0 0	11 0 0
" (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
" (Lancs. Boiler)	11 5 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	8 2 6 to 8 12 6	
Intermediate Basic	7 12 6	—
Soft Basic	7 0 0	—
Hoops	11 10 0	—
Soft Wire Rods	9 5 0	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 10 0 to 6 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	13 17 6 to 14 0 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/4½ to 18/6
Block Tin (cash)	296 5 0
" (three months)	288 10 0
Copper (cash)	55 10 0
" (three months)	55 17 6
Spanish Lead (cash)	23 3 9
" (three months)	23 13 9
Spelter (cash)	28 7 6
" (three months)	28 6 3
Manchester—	
Copper, Best Selected Ingots	61 12 6
" Electrolytic	62 15 0
" Strong Sheets	86 0 0
" Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
" Condenser, lb.	0 1 1½
Lead, English	24 15 0
" Foreign	23 15 0
Spelter	28 10 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/4 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
" " 6 p.c. to 8 p.c. "	£22 15 0	7/3
" " 8 p.c. to 10 p.c. "	£22 7 6	6/6
" " Specially Refined		
" Max. 2 p.c. carbon	£36 5 0	11/6
" " " 1 p.c. "	£42 5 0	15/-
" " " 0·70 p.c. carbon	£54 0 0	17/6
" " " carbon free	1/5 per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£12 10 0 for home, £16 for export	
" Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
" " 75 p.c.	£19 5 0 scale 6/- per unit	
" Vanadium	14/3 per lb.	
" Molybdenum	5/- per lb.	
" Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/6
" " Ell	13/9
" " Splint	15/6 to 17/6
" " Trebles	15/6
" " Doubles	14/6
" " Singles	13/6
Ayrshire—	
(f.o.b. Ports)—Steam	14/-
" " Jewel	15/6
" " Trebles	15/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/9 to 14/-
Screened Navigation	18/- to 19/-
Trebles	16/- to 16/6
Doubles	15/-
Singles	13/6
Lothians—	
(f.o.b. Leith)—Best Steam	13/-
Secondary Steam	12/3
Trebles	16/- to 16/3
Doubles	15/3
Singles	13/6

ENGLAND.

(8) N.W. Coast—	
Steams	22/6
Household	42/6 to 58/6
Coke	24/- to 24/6
Northumberland—	
Best Steams	14/6
Second Steams	13/- to 13/6
Steam Smalls	10/-
Unscreened	13/- to 13/6
Household	21/- to 27/-
Durham—	
Best Gas	16/- to 16/3
Second	14/- to 14/6
Household	21/- to 27/-
Foundry Coke	19/- to 26/-

Sheffield—	Inland.	
Best Hand-picked Branch	27/6 to 28/6	—
Best Selected House Coal	21/- to 22/6	—
Screened House Coal	19/- to 21/-	—
" " Nuts	16/- to 17/6	—
Yorkshire Hards	16/- to 17/-	—
Derbyshire Hards	16/- to 17/-	—
Rough Slacks	10/6 to 11/6	—
Nutty Slacks	8/- to 9/-	—
Smalls	3/- to 5/6	—
Blast-furnace Coke (Inland)	21/- to 22/-*	—
" " (Export) f.o.b.		18/6 to 20/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	20/- to 20/6
Second Smokeless Large	19/- to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	18/- to 18/6
Best Black Vein Large	18/- to 19/-
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/6 to 18/-
Ordinary Eastern Valley Large	17/- to 17/6
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	20/6 to 21/-
" " Smalls	16/- to 16/6
No. 2 " Large	17/- to 17/6
" " Through	16/- to 16/6
" " Smalls	13/- to 14/-
Foundry Coke (export)	35/- to 40/-
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	23/6 to 24/6
Pitwood (ex ship)	28/6 to 29/-
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	28/- to 32/6
Red Vein	25/- to 30/-
Machine-made Cobbles	42/6 to 45/-
Nuts	40/- to 45/-
Beans	30/- to 32/6
Peas	18/6 to 20/6
Breaker Duff	8/- to 8/6
Rubbly Culm	8/6 to 9/3
Steam Coals:	
Large	18/6 to 19/6
Seconds	17/6 to 18/-
Smalls	10/- to 11/-
Cargo Through	15/6 to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow (b) Delivered Sheffield. (c) Delivered Birmingham. * Official quotation for pig iron producers.

French Engineering Notes.

(From our Correspondent in Paris.)

Steel Sales Organisations.

THE International Sales' Syndicate, which was constituted in Luxemburg in June last, with a view to centralising the sales of blooms and billets and rolled steel, has just met in Paris, when a further step is understood to have been taken in the direction of reviving the *comptoirs* for the sale of semi-manufactured steel and girders. It is proposed that each country shall have a national *comptoir* for centralising sales in its own market, and the foreign trade will be dealt with by an international union, which will dispose, in export markets, of a tonnage to be fixed for each of the producing countries. This will really be a growth of the Steel Cartel, the operations of which have not been entirely satisfactory, particularly in Germany, although it has certainly saved the steel industry in other countries from disaster, and the Germans themselves are anxious to complete the organisation by confiding the sale to central bodies, whereby all would have a fair share of the trade without price-cutting due to competition. The old girder syndicate worked quite satisfactorily before the war, and the French tube makers have no reason to complain of the operation of their sales organisation, which has been in existence for quite a long time. This attempt to bring all the iron and steel trade interests into line by ensuring that each country and each manufacturer would have a proportionate share of the home and foreign business at prices which would leave a reasonable profit is regarded as absolutely essential at a time when the iron and steel production has far exceeded requirements, and it is believed to provide the only possible means of avoiding a collapse such as was threatened last year. The situation is worse now than it was then. The steel consumption on the Continent, outside Germany, has probably never been so low, and manufacturers are generally agreed that in the present unsatisfactory economic situation it is better to produce less under conditions that will provide them with a certain profit.

Railway Speeds.

In commercial speeds the French railways now rank second only to those of Great Britain, and a list has just been published giving the performances of 157 trains, the speeds of which are not below 49·75 miles an hour. The fastest train is the No. 185, running between Paris and Saint-Quentin, a distance of 95 miles, in 1 h. 34 min., or an average of 60·6 miles an hour. On the Nord there are no fewer than 30 trains travelling at more than 56 miles an hour, and the longest non-stop run is 190 miles between Paris and Dunkirk at an average of 55·5 miles an hour. The only other company exceeding 56 miles is the Est, with a train that runs between Chaumont and Troyes at a speed of 56·6 miles. The Sud Express on the Orleans line makes an average of 56 miles an hour between Les Aubrais and Saint-Pierre-de-Corps. There are 52 trains on different lines travelling at average speeds ranging from 40·5 and 56 miles an hour. These results are particularly remarkable because, after the Armistice, the French railways were in a very bad state on account of the heavy wear and tear during four years of hostitilities, when there was no means of maintaining them, while on the Nord a considerable part of the system had to be entirely reconstructed. Probably in no other country has there been so much progress in railway construction and equipment since then.

The Kembs Power Station.

Now that the Senate has approved of the Bill granting a concession to the Société des Forces Motrices du Haut-Rhin for the construction of the first section of the Alsace Canal with a power station at Kembs, it is probable that the work will be put in hand forthwith. The dam which is to be constructed across the Rhine to provide a maximum of 850 cubic metres of water per second to the canal will be carried out on behalf of the State at an estimated cost of 65 million francs. The raising of the necessary funds will devolve upon the company, which will be reimbursed by the State by means of annuities, the State remaining the owner of the barrage. As compensation for the use of the Swiss part of the Rhine 20 per cent. of the power generated will be available for Switzerland, and the company will be required to supply a certain quantity of energy to Germany.

Rural Electrification.

The programme of rural electrification has been making very slow progress, partly because so many hydro-electric schemes have been abandoned or held up, but also because the big power stations are not disposed to go to the trouble of extending high-tension mains into rural districts where the cost of the current is higher than consumers will usually pay. Nevertheless, a fairly large proportion of the communes is already electrified, and hundreds of others have applied for the State subsidy to enable them to lay down plants for local requirements. The State has been unable to meet the demands, and the Government has found it necessary to issue a warning to the communes to exercise caution in preparing plans for electrification, particularly in the way of grouping interests and depending as far as possible upon the power stations in industrial areas. The tendency of most communes has been to lay down small plants of their own. The Government further states that, with the improvement in national finances, it is now able to provide subsidies for rural electrification. It is expected that the scheme for the electrification of the country will be completed within ten years.

Cast Motor Chassis.

At the Académie des Sciences Monsieur Léon Guillet presented a motor car chassis cast entirely in an aluminium alloy without any welding or riveting. This alloy, which is largely employed in motor car construction, contains, it is stated, 13 per cent. of silicon, and its ultimate strength—which is given as being 30 kilos. per square millimetre, with an elongation of 8 per cent.—depends largely upon the rapidity of cooling. The chassis weighs 335 lb. It will have a 10 H.P. six-cylinder engine, and the car complete will weigh 1640 lb., as compared with 3000 lb. for an ordinary chassis with an engine of the same power.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

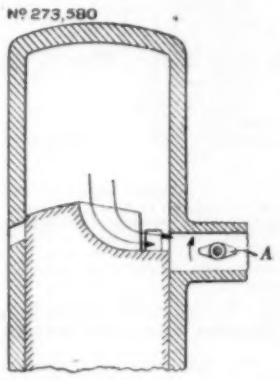
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

273,580. August 4th, 1926.—SCAVENGING OF TWO-STROKE ENGINES, T. V. Hemmingsen, Ove Billes Tvaervej 4, Copenhagen, Denmark.

This invention is another of those in which the simple two-stroke engine is elaborated by the provision of a valve in the exhaust port for the purpose of checking the waste of the next combustible charge, and incidentally maintaining the pressure of the new charge in the cylinder, so that the engine may work at a normal pressure above that of the atmosphere. To this end

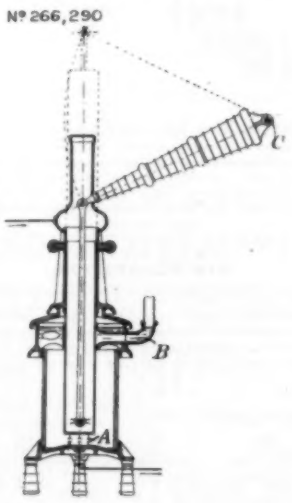


a throttle valve A is provided in the exhaust passage, which is positively driven from the engine crank shaft, and the claim is for: "A two-stroke internal combustion engine wherein a charging pressure above atmospheric pressure is obtained by throttling the exhaust passage during part of the scavenging period by means of a rotating throttle disposed in the exhaust pipe close to the cylinder, characterised in that a disc valve is employed for the purpose of throttling the exhaust passage."—*July 7th*, 1927.

SWITCHGEAR.

266,290. October 22nd, 1926.—IMPROVEMENTS IN OIL BREAK ELECTRIC SWITCHES, Luigi Magrini, of Bergamo, Italy.

By raising the piston, as indicated by the dotted lines, the contacts A are opened and the empty space left behind the piston is filled with the gas produced by the decomposition of the oil.

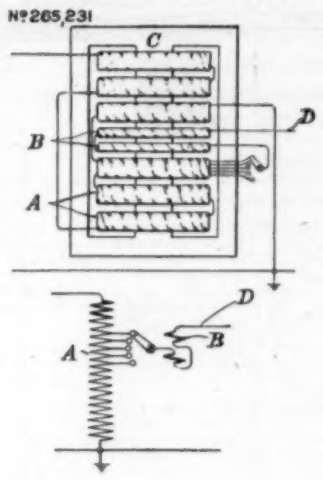


At the same time the oil flows into the lower part of the cavity and swamps the contacts A. As soon as the piston uncovers the mouth of the tube B the gases are discharged into the atmosphere. The piston is actuated by an insulated lever pivoted at the point C.—*July 14th*, 1927.

TRANSFORMERS AND CONVERTERS.

265,231. January 29th, 1927.—IMPROVEMENTS IN AND RELATING TO ELECTRIC TRANSFORMERS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

Auto-transformers having some of their turns provided with tappings and a tapping switch for varying the ratio of transformation are sometimes used for interconnecting two transmission lines or systems, the adjustment of the ratio of voltage transformation being used to control the flow of energy between the lines or systems. When a high-voltage transient of high frequency or steep wave front enters a terminal at one end of a transformer winding, the inductance of the winding causes a concentration of the voltage in the end turns, and an extra heavy or buffer insulation is usually provided on those turns to prevent damage to the windings. This, however, is not practicable with winding turns having tappings, because the tappings are usually distributed along the winding for some distance and protection for the tapping leads and tapping switch is also desirable. One object of this invention is to provide buffer turns which will afford protection for the tap switch, the tap leads and the tapped turns of the winding; another object being to arrange these turns so that their presence may not have an objectionable effect on reactance conditions in main transformer windings. The winding A is composed of disc coils interleaved to reduce reactance. The main connections can be followed from the diagram, extra heavy insulation being indicated by the heavy lines in the lower diagram, where B is a protective winding

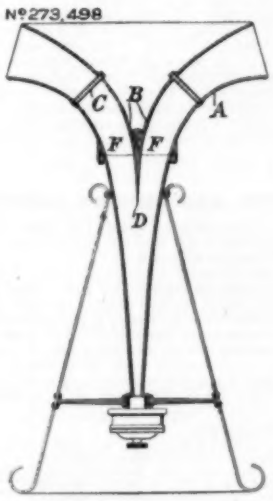


which surrounds the winding leg C. By means of the tapping switch the line conductor D may thus be connected through the protective winding B to any selected tapping on the main winding. The purpose of the winding B is to provide a few turns with sufficient reactance to protect the tapping switch, tapping leads and tapped portion of the winding from the high effect of an abnormal voltage arising from high-frequency line transients.—*July 7th*, 1927.

TELEGRAPHS AND TELEPHONES.

273,498. July 9th, 1926.—IMPROVEMENTS IN AND RELATING TO LOUD-SPEAKING TELEPHONIC RECEIVERS, Sebastian Ziani de Ferranti and Ferranti Ltd.

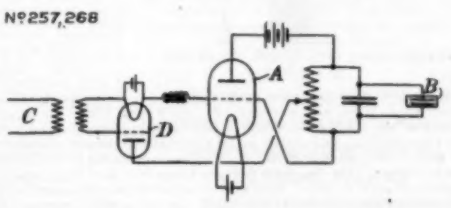
The usual type of loud-speaker horn projects the sound waves most strongly as a divergent conical beam along an axis continuous with that of the larger end of the horn. In many cases, however, it is more desirable that the waves should be radiated in a more uniform manner in all directions in an approximately



horizontal plane. According to this invention, the horn A is formed about a vertical axis with a conical deflector B. This deflector, which is supported at the points C C, tapers to a fine point at D. The cross sectional area of the duct F gradually increases from the point D upwards, and when the cross sectional area has reached the maximum value at the periphery of the horn, the direction of the axis of the sound ducts is approximately at right angles to the original axis.—*July 7th*, 1927.

257,268. August 17th, 1926.—IMPROVEMENTS IN OR RELATING TO "KERR" CELLS AND CONTROL MEANS THEREFOR, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 9, Tempelhofer Ufer, Berlin, Germany.

This specification describes means of controlling "Kerr"



cells. In the diagram A is a valve, which generates oscillations, and it is included in a circuit of the so-called "three-point" type. B is the "Kerr" cell connected across a condenser in the valve oscillating circuit. The valve is tuned to generate a frequency of 10^8 or a higher frequency. The incoming signal or signals to be repeated are supplied over a circuit C to the grid of the valve D, which is connected across the grid and cathode of the oscillating valve A. Variations of energy are thus produced at the "Kerr" cell which differ from the oscillation frequency of the transmitter, the cell being influenced by voltages at high frequency.—*July 14th*, 1927.

260,626. November 1st, 1926.—IMPROVEMENTS IN SIGNALLING CABLES, Siemens-Schuckertwerke Gesellschaft mit beschrankter Haftung, of Berlin-Siemensstadt, Germany.

In the case of signalling cables in which the quads consist of two pairs of wires stranded with one another, it is desirable to obtain a definite value of the ratio between the quad capacities C v and

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the pair capacities C p, since the installation becomes more economical as the ratio $\frac{C\,v}{C\,p}$ approaches the value 1·8 or 2. With the usual form of cable, however, it has not been possible to obtain this value. In accordance with the invention each of the telephone wires A is provided with paper insulation B, and intermediate layers C of folded paper are arranged between the two wires forming each pair, which are provided with an insulated covering D. The quad, consisting of two pairs, is provided with a common taping E.—*July 14th*, 1927.

266,749. February 26th, 1927.—IMPROVEMENTS IN OR RELATING TO THERMIONIC AMPLIFIERS, *Marconi's Wireless Telegraph Company, Ltd., of Marconi House, Strand, London, W.C. 2.*

This invention relates to thermionic amplifiers, adapted to amplify electrical impulses of audio frequencies, and has for its principal object the provision of a substantially distortionless audio frequency amplifier, in which the grids of the amplifying valves are kept at a potential negative with respect to the negative end of the filament. The main connections will readily be understood by those familiar with amplifiers. At A there is

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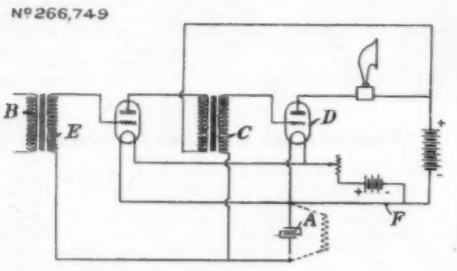

a condenser of sufficient size to by-pass all frequencies for which the amplifier is designed, a condenser of 1 microfarad usually being sufficient. The audio frequency currents to be amplified are caused to flow through the primary B of the first transformer. The successive positive halves of the alternations of potential of the grid end of the secondary C draw electrons to the grid of the valve D until the condenser A is so charged that both transformer secondaries E and C and the grids of both valves are at a negative potential with respect to the negative filament lead F, and this negative potential is approximately equal to the peak voltage of the secondary C of the last transformer.—*July 14th*, 1927.

MEASURING AND TESTING INSTRUMENTS.

260,551. July 27th, 1926.—DEVICE FOR IMPROVING THE TEMPERATURE ERROR IN ELECTRICITY METERS, Landis and Gyr S.A., Zug, Switzerland.

This invention relates to a device for improving the temperature error in electricity meters, and more particularly to that type of device in which the disc or other member or members on which the braking action is exerted is constructed of a material having a low-temperature coefficient. As an example a suitable alloy consists of aluminium, 96·25 per cent.; copper, 2·82 per cent.; silicon, ·70 per cent.; iron, ·23 per cent. Experiments have shown that the ohmic resistance of such a disc increases

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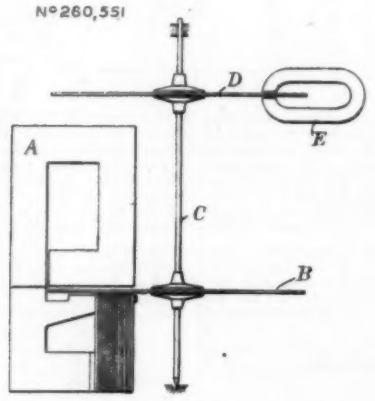

by ·00284 per cent. for each degree rise in temperature, as compared with an increase of ·0039 per cent. for a disc formed only of aluminium. The drawing shows one form of construction as applied to an alternating-current meter. A is the driving system, B the driving disc consisting of aluminium or of copper. On the shaft C there is another disc D on which a brake magnet E acts. This disc consists of an aluminium alloy containing copper-silicon and iron. In multi-phase meters with a number of driving systems, one or more discs or drums formed of the special material may be added to the existing discs, on which one or more brake magnets act.—*July 14th*, 1927.

GAS PRODUCERS.

273,474. June 18th, 1926.—THE DESTRUCTIVE DISTILLATION OF COAL, F. J. West, E. West and West's Gas Improvement Company, Ltd., Albion Works, Miles Platting, Manchester.

In this specification the inventors state that by research and experiment they have found that if the steaming of a retort be carried out to such a degree at the expense of the coke as to produce an exceedingly large volume of gas which has a low calorific value, and if the waste gases from the vertical retort setting, in which the distillation has been effected, be then utilised in a retort or generator for oil gas forming a part of the setting, and the coal gas and oil gas be subsequently mixed to produce a gas of the desired calorific value, then a very economical and

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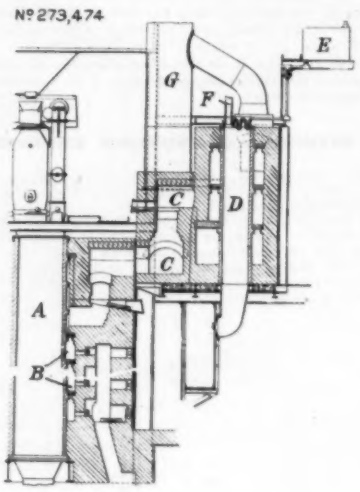

efficient process of gas production results. In the illustration the coal-distilling retort is shown at A, and is heated by gas burning in the passages B B. The products of combustion are taken by the flues C C to heat the oil gas generator D, which is fed with oil from the tank E. The oil gas goes away by the pipe F for cleaning and mixing with the retort gas, while the flue gases are accommodated by the chimney G.—*July 7th*, 1927.

CRANES AND CONVEYORS.

273,494. July 8th, 1926.—DRIVING MECHANISM FOR JIGGING CONVEYORS, Dr. K. Stroedter, 77, Alleestrasse, Bochum, Germany.

It is somewhat difficult to find just which is the precise element of novelty for which claim is made in this specification, but it is obvious that the form of movement for the conveyor, aimed at by the inventor, is that illustrated by Fig. 1. This movement is

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Fig. 2

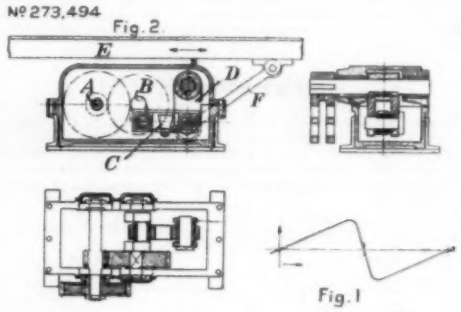

Fig. 1

obtained by the linkwork shown in Fig. 2, in which the shaft A is driven by any convenient motor. This shaft drives the crank shaft B through the gears shown, and a connecting-rod C operates the swinging link D, which is coupled with the conveyor through E by means of a pitman F. It is stipulated that the ratio of the crank throw to the length of the connecting-rod should not be greater than 1 to 3·5.—*July 7th*, 1927.

MISCELLANEOUS.

273,557. November 4th, 1926.—PIPE JOINTS, Aiton and Co., Ltd., Stores-road, Derby, and J. A. Aiton.

In this specification it is pointed out that if wrought pipes are flanged out for the purpose of being jointed by means of loose flanges, the flanged part of the pipe must be thinner than the

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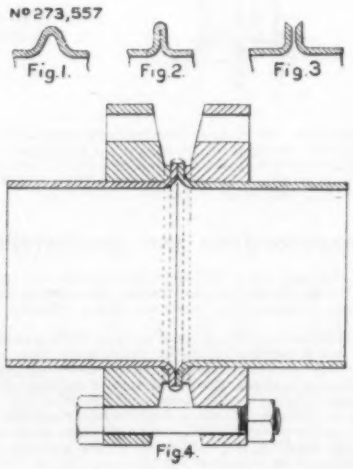

main body. To meet this difficulty the pipe is heated circumferentially and locally, and is pressed axially, so that it develops the form shown in Figs. 1 and 2 progressively. The two sections are then parted, as shown at Fig. 3, and are bolted together in normal fashion, viz., Fig. 4.—*July 7th*, 1927.

273,550. October 21st, 1926.—THE AUTOMATIC CONTROL OF FLAMES, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2.*

This apparatus is intended for such service, as in the manufacture of electric glow lamps, where a blow-pipe flame of constant intensity is required regardless of the thermal value of the various constituents of the gas being burned. The working burners are shown at A A and are supplied with gas and air by the pipes B and C respectively. Branches from the two pipes

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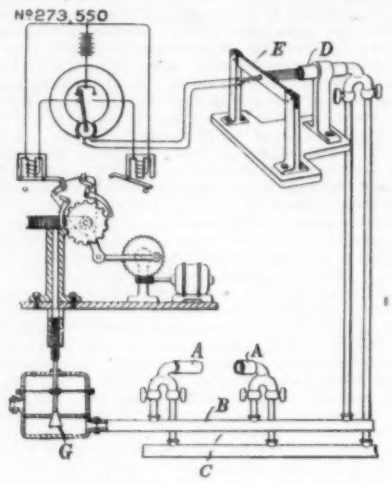

are taken to a test burner D, which is directed against a band of Nichrome E. This flame is so adjusted that it heats the band with a ring of incandescence, with a centre of comparative coolness. Behind this cool centre there is arranged a thermo-couple, which controls the main gas supply through the valve G. If the test flame tends to fade, the area of the cool centre surrounding the thermo-couple decreases, the thermo-couple is energised more vigorously and more gas is admitted by the valve G. The reverse takes place if the test flame loses its intensity.—*July 7th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY TO WEDNESDAY, AUGUST 31ST TO SEPTEMBER 7TH.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Meetings at Leeds.

TUESDAY TO FRIDAY, SEPTEMBER 6TH TO 9TH.

THE INSTITUTE OF METALS.—Annual meeting at Derby. For programme see page 148.

THURSDAY TO SATURDAY, SEPTEMBER 8TH TO 24TH.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia, London, W. 6.

CONTRACTS.

MERRYWEATHER AND SONS, Ltd., of Greenwich, have received an order to supply the fireproof curtain, fire mains, sprinkler installation, hand-fire extinguishers, &c., for the new theatre to be erected in Denman-street, W., by Messrs. Griggs and Sons, to the designs of Mr. Bertie Crewe and Mr. A. E. Stone.

THE PATERSON ENGINEERING COMPANY, Ltd., Windsor House, Kingsway, London, W.C. 2, has received a contract for a filtration plant of 10,000,000 gallons daily capacity for the new Johore water supply for Singapore. This plant is the first instalment of an ultimate scheme embodying a filtration plant of 20,000,000 gallons daily capacity.

SIR WILLIAM ARROL AND CO., Ltd., of 59, Palace-street, Victoria-street, Westminster, S.W. 1, inform us that among recent orders for export, received by its crane works at Parkhead, are the following:—(*a*) Overhead electric travelling cranes: two of 120 tons overhead and a number of smaller ones for India; four of 100 tons for New Zealand; and two of 50 tons for Perak; (*b*) two "Temperley" electric travelling tower transporters to handle a gross load of 6 tons each, for Canada; (*c*) two portable "Temperley" transporter beams for Germany; and (*d*) one 5-ton overhead electric traveller for British Columbia. The company has also secured the order for dock gates for Calcutta, which will be manufactured at its Dalmarnock Ironworks.

RANSOMES AND RAPIER, Ltd., of Ipswich, inform us that during the month of July they received orders for the following Ransome-Rapier-Marion excavators:—From Charles Tennant, Sons and Co., Ltd., of Swansea, for a Type 7 steam dragline machine; from the Standard Portland Cement Company, of Sydney, Australia, for a type 7 electric shovel; from the Union Minière de Haut Katanga, Belgian Congo, for a type 7 electric shovel (repeat order); and from Vulcan Refractories, Ltd., of Melbourne, Australia, for a type 7 steam shovel. These four machines are all of one cubic yard capacity. The firm's Associate Company, the Marion Steam Shovel Company, of Ohio, U.S.A., in the same month received an order for a 15 cubic yard electric shovel which will be by far and away the biggest excavator ever built.

THE ENGLISH ELECTRIC COMPANY, of Queen's House, Kingsway, London, W.C. 2, has, it informs us, secured an important contract for the complete electrification of the line from Christchurch to Lyttelton, New Zealand. The order comprises the overhead line equipment amounting to 45,000 yards of overhead line material, six "English Electric" 1500-volt locomotives of the 3ft. 6in. gauge 4-axle type. Two rotaries will be supplied of the single commutator 1500-volt type which will be completely automatic in operation. Remote control is to be arranged from both Addington and Christchurch stations. The transformers for supplying the converters will be of the standard outdoor type. The contract is in the neighbourhood of £100,000, and it was secured in open competition with reputable manufacturers of the world.